CHAPTER 2

IMPLEMENTATION GUIDANCE FOR OPERATIONAL CONFIGURATION MANAGEMENT

This guidance is appropriate for high-hazard facilities expected to operate for an extended period. Since DOE facilities vary in hazard level and circumstances of operation, a graded approach to implementation should be adopted.

2.1 PROGRAM MANAGEMENT ELEMENT

The program management element of a configuration management (CM) program coordinates program development and implementation and ensures overall program effectiveness. This element leads the development of the other CM program elements. Development of an effective CM program should be initiated promptly, where needed, to address known issues, to improve compliance with various DOE Orders, and to produce the benefits of improved safety, reduced errors, and increased efficiency. Configuration management program definition and development necessitates the establishment of local CM policy, philosophy, requirements, and strategies for development and implementation.

Configuration management program development activities should be performed in a phased manner and should include milestones. Initially, development activities should focus on preparation of CM program directives and plans. The CM program criteria indicate that the CM program plan should be provided to DOE for review within 18 months of initiation of planning. Development of the CM program elements begins after CM program plan concurrence and should be completed within 2 to 3 years (for a large, complex facility). Program implementation should be initiated as each element is developed, with full implementation of the five CM program elements, including satisfactory post-implementation assessment, within 5 years. Adjunct programs such as design reconstitution could extend beyond 5 years. Once fully implemented, the CM program functions should be maintained throughout the life of the facility. Figure 2–1 provides an overview of the schedule for CM program development and implementation.

In the following sections, program management is described by function in the general order of its Chronological development. The concepts and terminology, and equipment scope criteria functions are discussed under program planning.

2.1.1 PROGRAM PLANNING

The CM program planning phase is of critical importance because it sets the direction and tone for future development and implementation activities. Configuration management policy development is a top-down activity, beginning with a general set of CM program criteria established at the site/division level. The CM directives should be issued initially at the highest level of management (site/division) and flow downward to the facility management level. In contrast with policy development, technical program planning starts at the facility level and flows up to the site/division level. The site/division CM program plan should be a consolidation of the facility CM program plans and should provide for implementation variations for different facilities based on hazard levels, operational constraints, and other variables. Figure 2–2 reflects the basic steps necessary for CM program planning.

Through review and concurrence with the CM program plan, DOE acknowledges that the plan defines the appropriate level of implementation, based upon the CM program criteria and the graded approach. Once reviewed, the plan serves as the basis for future assessments of program effectiveness and

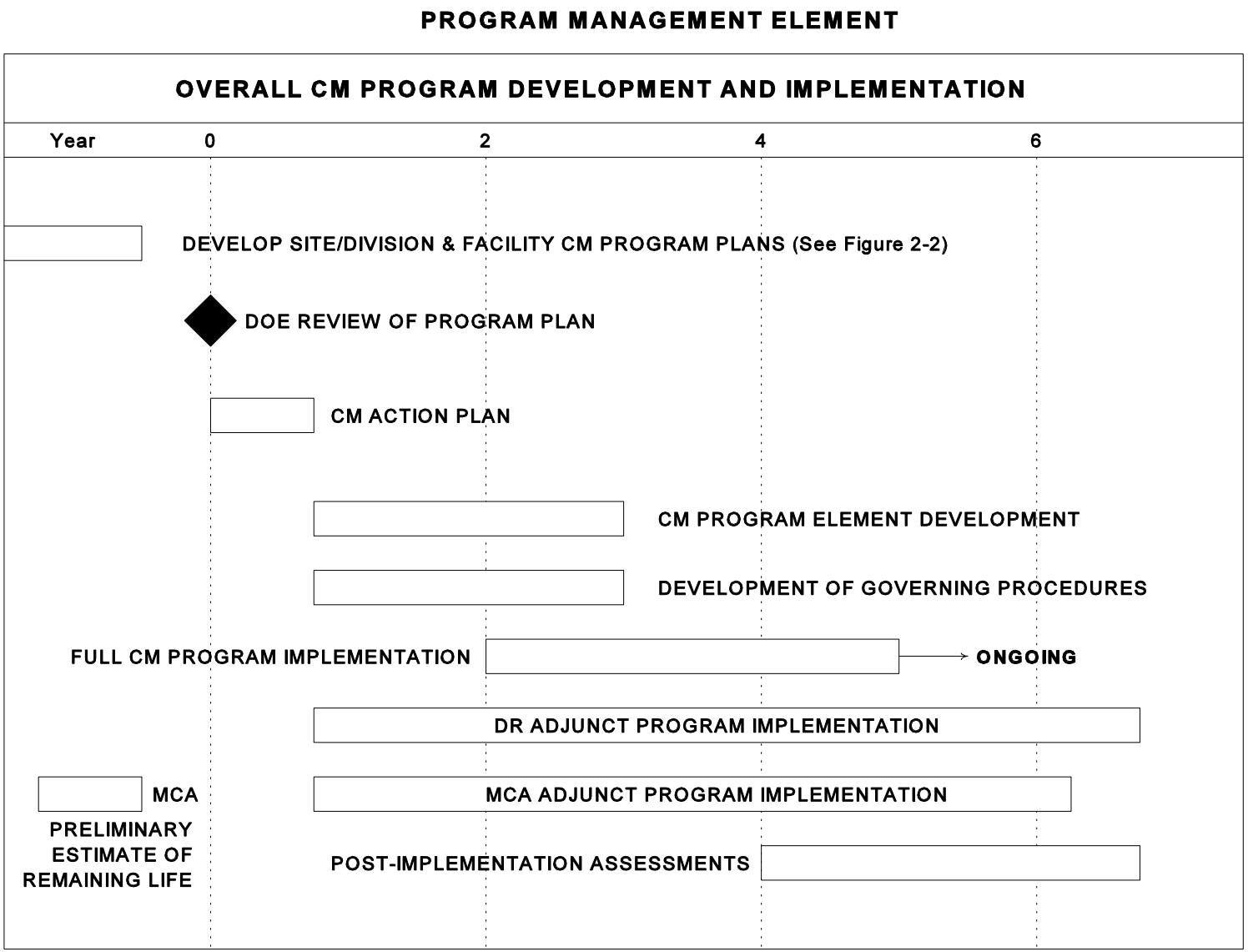

Figure 2-1. Program Management Element: Overall CM Program Development and Implementation

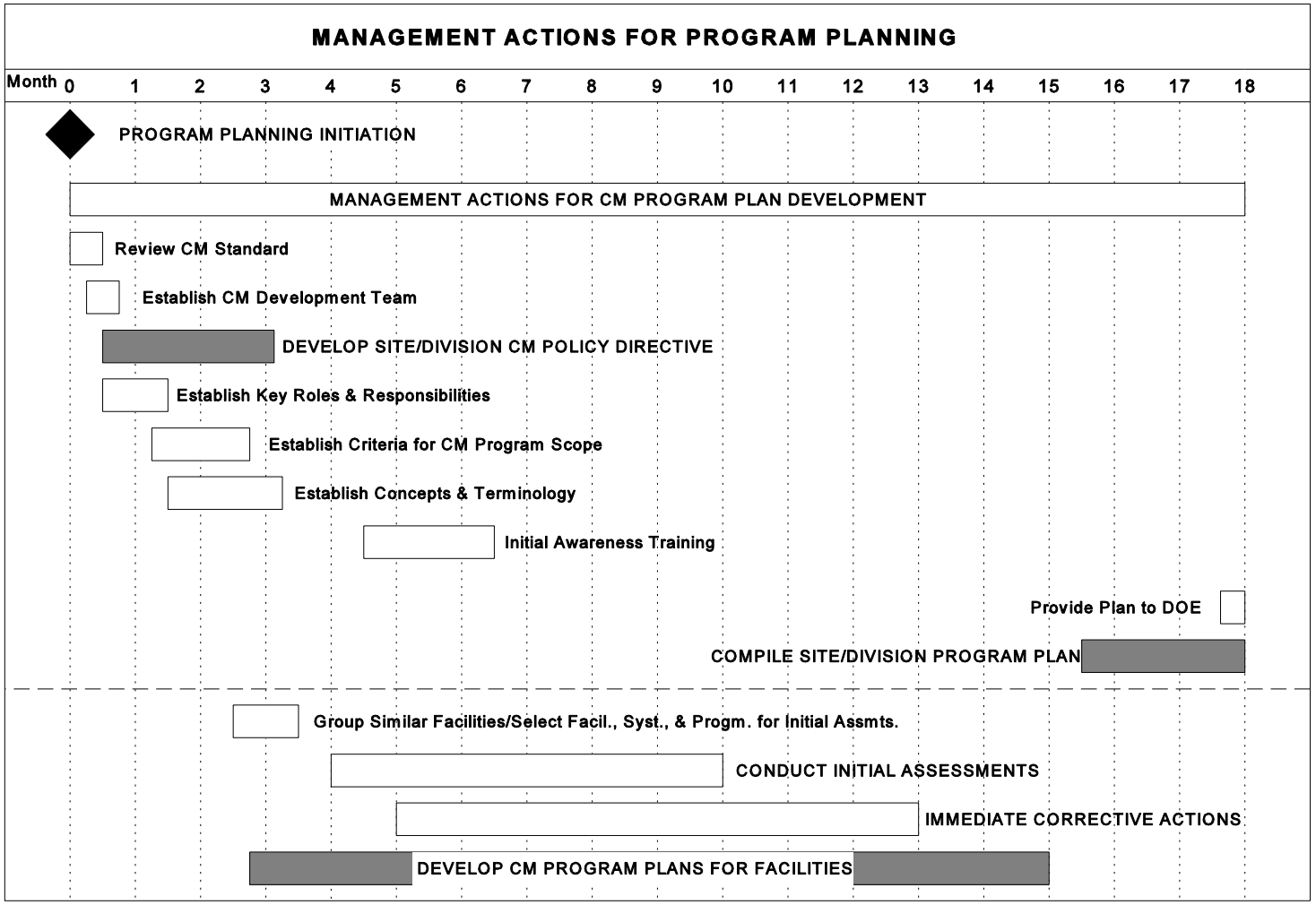

Figure 2-2. Program Management Element: Management Actions for Program Planning

external audits. The program plan should be treated as a living document; it should be revised only as necessary to reflect changes In program implementation. Proposed revisions to the CM program plan should also be provided to DOE.

2.1.1.1 CM Policy Directives

Effective program management begins with a clear understanding and statement of management's expectations. These expectations should be documented In a top-level management, site/division policy directive specific to the subject. Configuration management directives provide the structure and foundation for program development. These directives lead detailed program planning and program element development., Per program criterion 1.3.1.1.a, the site/division CM policy directive should accomplish the following objectives: convey top management support, define key roles and responsibilities, provide the equipment scope criteria for the CM program, and establish key concepts and terminology.

The principles of operational configuration management need to be understood and accepted by facility personnel and integrated into their daily activities in order for the program to be effective. Management has to clearly show support for the CM program and communicate its commitment to every level of the organization for the effort to be successful. The CM policy directive should reflect top management's decision, commitment, and support for the development and implementation of the CM program at each facility.

The CM policy directive should also define key roles and responsibilities for developing the CM program, Including the CM program plans. For example, it should formally empower a manager and organization to coordinate development of the CM program and clearly define their roles and responsibilities. If a central CM program organization is established, it should be involved in any changes to existing programs that could affect configuration management. The directive could also define the roles, responsibilities, and interfaces of other organizations and programs for development of the CM program plan.

The CM policy directive should provide criteria for the scope of equipment to be included in the CM program. The scope criteria provide the foundation for identifying the specific structures, systems, and components (SSCs) and associated documents to be included in the program. This effort has a direct impact on program effectiveness, costs, and schedules. Therefore, establishing the technical scope of the program is crucial. As indicated by program criterion 1.3.1.2, SSCs with safety, environmental, and mission design requirements should be included in the CM program. Other SSCs should be included as an option; however, program cost and manageability should be considered.

Establishing the scope of equipment involves defining both the general categories of equipment and the specific criteria for its categorization. Input as to the existing categorization and recommended revisions, if needed, should be obtained from the design authority. Sites/divisions should also establish criteria and guidance specific to each category of design requirements. In fact, most sites/divisions have existing mission criteria that might be useful to this end. As an example, the mission criteria might be defined as including equipment whose failure could create a forced shutdown for 180 days or more. Also, facilities may have existing safety criteria, such as thresholds based on DOE 6430.1A, *General Design Criteria* (Section 1300-3.2). Sites/divisions should re-review existing criteria; provide any additional criteria, guidance, or clarifications; and formally establish the criteria within the CM program for design requirement categorization.

Finally, the CM policy directive should establish CM program concepts, terminology, and definitions to ensure consistent usage and understanding, both within the program and among the various interfacing programs and organizations. Many of the concepts and terms currently used regarding configuration

management derive from different programs and have various meanings depending on the context in which they are used. CM concepts, standard terminology, and standard definitions should be established in accordance with the definitions provided in the glossary provided in this Standard. These key concepts and terminology, supported by a functional model of the site/division CM program, ensure a consistent approach to facility CM program development. The site/division CM directive) should formally adopt the CM program objective, functional model, and the functions to be used by the facilities within the site/division.

Directives are also useful for establishing other upper-level CM policy and immediate actions relative to program management functions such as database control and procedure development.

Figure 2–2 shows the process of establishing an interim CM development team dedicated and committed to CM program development. This is the recommended approach because of the work and interface efforts involved. To ensure an understanding of the needs and capabilities of the organization as a whole, the team should be balanced with experienced personnel from different work areas. Where several facilities are under the jurisdiction of a single management and operations (M&O) contractor, the CM developmental team should have a mix of representatives from various facilities and groups within the organization.

The CM development team should have a charter stipulating the activities consistent with its role in coordinating overall CM program development. Such activities could include developing a formal site/division CM directive for management approval early in the development process, working closely with each site/division manager to develop directives, and providing support to each facility during the development of the facility-level CM program plans. The details of program implementation should be a line management function, but a small core group is usually maintained to provide the program management functions necessary to ensure the proper implementation of the overall CM program.

2.1.1.2 Planning for Initial Assessments

Site/division managers should take the lead in planning and coordinating initial assessments. These assessments identify programmatic strengths and weaknesses for use as a basis for CM program planning and for immediate corrective actions. As a first step, facilities should be grouped according to mission, design, complexity, size, and other appropriate criteria. This action would allow for greater efficiency in the assessment process. For similar facilities with similar CM practices, an assessment of such practices for one site would be representative of them all. As a further example, several facilities might use a central or common approach to document control; single assessment in this programmatic area could be representative for several facilities.

Second, the specific representative facilities, systems, programs, and topical areas should be selected for the initial assessments. Site/division managers should coordinate assessment activities such as the selection of assessment teams, training, and funding. Sites/divisions could elect to go beyond the minimum requirements in the initial assessments; the subjects of the other assessments would be based on a judgment of needs. The initial assessments are conducted in accordance with the criteria and guidance associated with the assessments element. When the representative assessments are complete and the results are available, this information should be shared with other facilities in the group (i.e., those found to be similar enough not to need separate initial assessments). Each facility in the group should factor these assessment results into its facility CM program planning.

DOE may specify certain approaches to implementing a CM program on the basis of facility importance or budget considerations. For example, it may elect to use certain lead facilities as pilots and to have the others follow in a phased manner. Thus, lessons learned in the initial assessments, program planning, and program development for pilot facilities can be applied to the remaining facilities for

greater cost-effectiveness. Wherever the pilot approach is pursued, priority attention to timely assessment of the change control functions is warranted.

2.1.1.3 Initiation of Immediate Corrective Actions and Interim Upgrade Actions

The initial assessments should be conducted as planned and directed from the site/division level. If the initial assessments of programs and procedures reveal major weaknesses that warrant corrective action prior to the complete development and Implementation of the CM program, management should initiate immediate corrective actions to mitigate these weaknesses. These immediate measures may be replaced by Improved processes as the CM program matures.

Priority attention should be given to identifying and stopping uncontrolled and unauthorized changes to the facility. If the initial assessments determine that uncontrolled changes are occurring, ft facility should initiate immediate corrective actions, such as implementing an Interim change control program. An effective approach to interim change control is lo require that nondesign organizations send all potential changes to the design engineering organization for evaluation. This action may have to remain in place until the change control element is fully implemented and design reconstitution efforts are complete.

An Interim upgrade of existing document control processes may also be necessary to ensure a proper interface with the change control program and to improve document accuracy or retrievability. Other areas that should receive priority attention, where major weaknesses are identified, are facility walkdowns to establish the physical facility configuration and a formal review of summary design information to establish an initial set of design requirements.

Interim measures are vital to prevent the continuing loss of facility configuration, thereby invalidating other CM activities such as drawing and procedural updates. To the extent practical, interim measures should be taken within existing program and organizational structures. In some cases, it may be necessary to halt existing programs or processes temporarily until upgrade actions are completed. Interim measures should be replaced by improved programs and processes, implemented within normal line management structures, as the CM program matures.

2.1.1.4 Facility Program Plans

After the site/division directive is issued, facilities should apply the directive and develop facility CM program plans. Configuration management program criterion 1.3.1.1.c identifies the topics that should be addressed by CM program plans. The facility should adopt equipment scope criteria consistent with the site/division policy directive. The facility should also review the site/division CM policy directive to determine whether the equipment scope criteria for SSC inclusion can be applied as is or need modification or clarification at the facility level. The CM program plan should identify the specific criteria for each design requirement type. The specific list of SSCs is not necessary at this stage of program development.

Much of the CM program plan will focus on the objectives and description of the CM program activities needed to develop and implement each program element and function. A CM program plan format organized by program elements and functions is likely to facilitate efficient application and review. The development and implementation of each CM program element and function should be consistent with the program criteria and the CM directive from site/division management. As an example, under the program management element, the CM program plan should include descriptions of plans for establishing appropriate interfaces, including vendor control; plans for developing CM governing and implementing procedures, including associated training; and plans and criteria for CM equipment and document databases.

The bases for the technical content of the CM program plan are (1) the findings of the initial assessments and (2) the application of the graded approach. For example, the preliminary estimate of a facility's remaining lifetime should be provided during the program planning phase and addressed in the program plan. Initial assessment results and immediate corrective actions in response to the initial assessments should be described in the facility CM program plan.

Completed activities should be described to demonstrate CM program functions that are implemented. For example, the CM program plan should describe the CM equipment scope criteria, the concepts and terminology adopted, and any initial CM training. To evaluate existing functions, the contractor should identity and analyze the existing program elements and functions, discuss the technical content of those procedures Implementing the CM functions using functional flowcharts, describe the assignments of responsibilities and authorities for configuration management, and define organizational and functional interfaces by which the CM program is integrated into a cohesive program. Then, the contractor should correlate the existing CM program elements and functions with the program criteria, describe how the existing program and procedural requirements satisfy these criteria, and describe how the existing program satisfies the CM objective. This analysis should build on the findings from the initial assessments, which use applicable horizontal assessment techniques. The results of this analysis should be documented in the CM program plan and should identify areas in which additional work is needed to rectify any discrepancies between the existing program and the CM program criteria discussed in Chapter 1. If DOE concurs that the combination of the existing CM program and identified improvements is adequate, this would constitute a program that meets the program criteria.

The CM program plan should identify the organization that will have overall responsibility for developing and implementing the CM program. It should include current staffing and a summary of key personnel. It should also include estimates of staffing necessary to complete CM program development, along with a staffing plan to meet these needs. Finally, the program plan should identify key organizational interfaces and provide flowcharts, as appropriate, to show programmatic and organizational relationships and responsibilities.

Once upgrade actions are identified, these should be prioritized both in relation to each other and in relation to other planned facilities activities. Schedules should be developed in accordance with these priorities. The CM program plan should provide schedules for implementation activities with defined deliverables for each milestone. Cost estimates should be identified for each activity or deliverable. The plan should also discuss the responsibilities and methods related to the management function of monitoring progress in the development and implementation of the CM program. Questions such as the following should be addressed:

- How will this monitoring be accomplished?
- What parameters will be used to gauge progress?
- How will problems be identified?
- What levels of facility management will receive periodic progress and problem reports?
- How will decisions to make midcourse adjustments to the program be made?
- Who in the contractors organization will be responsible and accountable for the progress achieved?

2.1.1.5 Site/Division CM Program Plans

Facility plans should be consolidated into a site/division CM program plan. This upper-tier program plan is intended to present both the individual facility CM program plans and additional summary information such as summary schedules and costs for the site/division. During compilation activities, the upper-level organization could ensure that the facility program plans are consistent with expectations. In some cases, individual facility program plans might not be needed where the facility

CM program can be fully described by an upper-tier program plan. The upper-tier program plan could be developed as the general program plan with additional descriptions and clarifications as to how it is applied to the individual facilities. In some cases, certain program elements or functions serve multiple facilities. For example, document control could be established centrally for multiple facilities. In such a case, the central document control measures would not have to be described in each facility's program plan; they could be described once in the upper-tier program plan.

2.1.2 INTERFACES

Interface Control. Starting during development of the CM directives and continuing through program planning and development, the CM program should identify and define the key programmatic and organizational interfaces. Defining effective and efficient interfaces, both internal and external, Is critical to the workability of a CM program.

Program interfaces are those relationships established to ensure that identification and integration of the key facility programs are such as to effectively support and maintain consistency among the design requirements, documents, and hardware. Program interfaces include those internal to the CM program, such as the interface between document control and change control, as well as those between the CM program and programs such as design control, project control (DOE 4700.1), surveillance testing, maintenance, and any program or mechanism involved in defining, evaluating, and documenting changes. As the fundamental approach to implementing the CM program is to identify, upgrade, and integrate these existing programs, the program management element should clearly identify these programmatic interfaces. Roles, responsibilities, and relationships among the program elements and functions should be defined and documented. Relationships to other programs that interface with the CM program should also be clearly defined and documented.

The CM program involves numerous interfaces among organizations. Organizational interfaces are those relationships established to ensure that key functional organizations (such as design engineering, operations, and maintenance) are aware of the roles, responsibilities, and interactions necessary for adherence to the CM program. Organizational interfaces can be internal interfaces within the facility, she, or corporate organization, as well as external interfaces with organizations outside the contractors corporate structure. The program management element should entail identifying, formalizing, and monitoring the organizational interfaces that can affect CM functions. Organizations and key personnel involved in developing, implementing, and managing CM program activities should be identified. Management expectations regarding the roles, responsibilities, and authorities of the organizations and key personnel should be clearly defined and documented. Contractors might find it worthwhile to designate CM program coordinators in each major organizational unit to ensure adequate interfaces. External interfaces might need to be implemented by contractor interface agreements or formal contracts, as appropriate.

Often, the weakest parts of CM program implementation are the interfaces between the program elements and the organizations implementing these elements. The accuracy and completeness of configuration information transferred within and across organizational and functional boundaries is the focus of the CM program, in that the transferred information establishes and maintains the CM program basic relationships. Since information needs to flow among interfacing programs and interfacing organizations (e.g., change control functions should provide current information to support document control functions), flowcharts are the recommended tool for defining and analyzing program and organizational interfaces. Flowcharts are particularly effective in identifying program interface points and thus in exposing weaknesses in program integration. Having learned this lesson, some organizations now use flowcharts as part of the development of every procedure. Procedure flowcharts should be functional, not administrative (i.e., showing only the handling of forms and documents, not necessarily the functions being performed along the way).

Vendor Control. Most DOE facilities use vendors or outside contractors for the performance of selected technical work such as design change package development, safety evaluations, specialized analyses, and construction. The greater the use of vendors, the greater the need for formal control. Vendors also supply facility equipment and materials. Technical vendor control is the process used to ensure that Important vendor activities and information support the facility's CM program.

The program management element should provide policy and procedures to ensure that important vendor activities and information are consistent with the CM program. The CM program should provide for the review and approval of vendor procedures prior to the commencement of work or impose the use of facility procedures in all work performed at the facility. In addition, acceptance criteria should be established by the facility to define when vendor work has been completed satisfactorily and is ready for turnover to the facility. After turnover, vendor information used by facility personnel should be incorporated directly into the facility document control program and kept current. The facility should have sufficient resources and talent to judge the quality of work and ensure adequate control over vendor activities. Vendor control measures might need to be implemented by contractor interface agreements and formal contracts, as appropriate.

Special problems can arise regarding the control and use of vendor technical information such as vendor manuals and notices. To simplify document turnover and control, facility management could choose to review vendor technical information and excerpt relevant portions for direct inclusion into facility procedures before that information is used by facility personnel. After turnover, vendor Information used by facility personnel should be incorporated directly into the facility document control program and kept current.

2.1.3 DATABASES

The extent and interrelationships of CM-related information necessitate the effective development of information systems such as databases, logs, indexes and cross-reference tracking systems, and change status tracking systems. Objectives in the design of such systems include minimizing the potential for conflicting versions of the same information in more than one system, maximizing the flexibility and speed of information searches, establishing clear accountabilities for generating information to be tracked and for tracking the information, ensuring that the information is, accessible to those who need it, preventing unauthorized changes to the information, establishing a single authority for any given information, and minimizing duplicated and otherwise redundant labor.

Well coordinated and controlled databases become primary focal points of effective CM programs. There are two general types of CM databases that need to be established and controlled: equipment databases and document databases. Equipment databases contain and correlate information about the SSCs within the CM program, while document databases convey information about the documents, including their status. Both databases provide information useful for the evaluation of changes. Properly designed and well-managed equipment and document databases are essential (configuration management tools; they support many functions important to safe facility operation. Such databases are included in the scope of the CM program because they contain and correlate vital configuration management information.

Because of the importance of these databases to the CM program, the program management element should define policies and procedures for establishing and controlling them. A site/division CM directive could be used to define general policy and criteria for CM equipment and document databases. The CM program plans should discuss the steps necessary for developing (or validating) and controlling these databases.

The program management element should identify the general contents of the two types of databases. Their format, content, and capabilities should be adapted based on the identified needs and intended uses. They should also be sized considering future needs by allowing for significant expansion of the number of data fields and types of information. The program management element should also identify controls for database development, implementation, and revision, especially those necessary to establish and maintain the quality of information.

The steps to develop effective CM databases should include the identification of those databases that contain CM-related information, the consolidation of related information into a few key databases, and the establishment of control mechanisms to ensure data quality and accuracy. An initial study should be conducted to identify existing equipment and document databases, their contents and uses, responsible organizations, and locations. The initial study should reflect the results of, and may be performed in conjunction with, other initial assessments.

On the basis of the initial study, an action plan should be developed to consolidate or eliminate as many of these databases as possible. A typical facility has many separate databases containing similar information, with minimal interfacing or administrative controls. As a result, these databases develop errors and inconsistencies, which contribute to configuration problems. A desirable approach is to have all facility information computerized, residing in a master database, and accessible from most locations within the facility. However, the time and investment for a new consolidated database should be weighed against the need to establish a few well controlled existing databases. In some cases, especially where databases are well coordinated and controlled, few changes are expected. In other cases, where many databases are in use, some containing offering data because they have not been coordinated or updated, more changes are appropriate. Key conclusions, milestones, and schedules from the database study and action plan should be reflected in the facility CM program plans.

Procedures should be developed for control of the quality of information within these databases (for example, procedures governing approvals, validation and verification of information, access and security, and revisions), and there should be methods for retrieval of that information consistent with the needs of the users. Special controls should be Instituted to ensure that any database used for Configuration management purposes will be protected to prevent inadvertent or unauthorized changes of the data. To be effective, the data collection function would have to be integrated into each CM - related process and specified in written procedures. Collection of the necessary data should be facilitated and standardized, and should be consistent with the normal flow of information. Data collection should be supported by forms that are designed to prompt the owner or user for the necessary information in a format that enables ready identification of the specific fields as well as verification that the necessary information is present, coordinated, and approved.

Equipment databases should specify equipment classifications, contain or reference equipment design requirements, and cross-reference supporting CM information. These databases should provide current information on facility SSCs and associated documents within the CM program, with emphasis on design documents. An approach that has proven successful elsewhere is the development of a computerized CM master equipment database that includes every facility component. Each component is assigned a unique identifier based on system, component type, and component function before it is included in the database. This database can serve as the primary source of descriptive, testing, and operational data on hardware and instrumentation. Equipment databases are discussed further in the implementation guidance for the design requirements program element.

Document databases provide basic information about the documents in the CM program. Both document and equipment databases include some relational information that links SSCs to documents. Document databases provide more extensive document-specific information than equipment databases, including information on change status and related documents (such as change notices and physical

changes in progress) and pending changes. They also provide the capability to relate documents based on types of documents, specific SSCs, groups of SSCs, technical topics, and other useful cross-referencing topics. Document databases are discussed further in the implementation guidance for the document control element.

2.1.4 CONFIGURATION MANAGEMENT PROCEDURES

This section discusses those vehicles or mechanisms that support CM program plans and directives by communicating increasing levels of detail on program direction and guidance. The program planning function provides top-level direction through CM policy directives and the CM program plan. The procedures function provides CM program direction through CM action plans, CM governing procedures and implementing procedures, and associated training.

2.1.4.1 Action Plans

Program management involves careful planning and effective controls to ensure that the effort is credible, timely, and cost-effective. Starting from the program plan, facilities should prepare action plans to provide further detail, as needed, on those program plan topics related to program development and implementation. These plans should serve as an important vehicle to get the various organizations and personnel at the facility to understand, accept, and support CM development efforts. They are the primary management tool for coordinating development and implementation activities; they should integrate and focus these activities to ensure that they can be implemented successfully, managed effectively, and monitored for progress. Configuration management action plans should be established promptly following DOE review of the CM program plan and before program development commences.

Action plans should provide detailed direction in the areas of task descriptions, methods, assignments, schedules, and budgets. They do not need to expound on the basis of the program. Action plans should be consistent with the program plan but expand on implementation particulars. Regarding assignments, for example, the program plan might identify divisions or departments responsible for development activities, while the action plan would identify specific responsible individuals. Regarding tasks and methods, where the program plan might, for example, state that the owners of each change control process will be identified and that they will evaluate and upgrade their processes, the action plan would identify more specific methods for process evaluation and upgrade, such as establishment of process improvement teams, interviews with process users, preparation of flowcharts, interactive sessions with trained facilitators, pilot implementation, and review by an executive sponsor and process improvement specialist. With regard to schedules and budgets, the program plan might, for example, establish a 2-year milestone for development and upgrade of the equipment database, while the action plan might divide the activity into 15 identifiable tasks, each with a task description, deliverables, milestones, a budget, and assigned personnel. Depending on program size and complexity, action plans might be prepared for each CM program element, or even for the more complex individual functions, such as databases or walkdowns.

Action plans should provide more detail than program plans on process and quality controls, interface control, communication methods, and progress-monitoring methods. They should identify how CM development activities and results will be communicated throughout the organization, such as through training, seminars, newsletters, and interdisciplinary teams. Action plans should also establish methods for measuring and controlling progress, including objective parameters against which progress can be measured, management accountabilities, regular internal status reports, and periodic management reviews to monitor progress and resolve problems in a timely manner. While the program plan is viewed as a commitment document and is revised only as needed, action plans should be revised periodically until implementation is complete to keep them useful and authoritative.

2.1.4.2 Governing Procedures

Configuration management governing procedures should be developed after the CM program plan has been reviewed by DOE and should support the action plan. Governing procedures should be developed for each CM program element and adjunct program and should address each program element function and its relationships. The CM program plan should identify the CM governing procedures that will be developed.

The CM governing procedures provide the framework for integrating the implementation of the CM program elements and functions. They should indicate how the CM functions are carried out in the various implementing procedures, and thus, how those functions conform with the CM program plan. The governing procedures describe how and when the CM program element is invoked and generally how its functions are executed with reference to the detailed implementing procedures. Once the CM governing procedures are in place, the CM program should be able to accomplish its objectives and functions by adhering to these procedures and maintaining and updating them as needed.

The primary goal of the governing procedures is to provide overall coordination and integration of the various implementing procedures and implementing organizations. As an example, a governing procedure on document control would reference, describe, and show interfaces among the implementing procedures for matters such as the drawing change process, the field change notice, the design change notice, record retention, document distribution, the identification of key words, and document tracking. Similarly, the change control governing procedure would identify implementing procedures for approved change mechanisms and for such activities as the conduct of technical reviews and the approval, implementation, and documentation of changes.

The CM governing procedures may also provide information useful for ensuring consistency in implementation, such as the following: statements of purpose and applicability, definitions, top-level CM program requirements (consistent with the CM program plan), key organizational interfaces, top-level roles and responsibilities, key programmatic interfaces, and functional flowcharts showing relationships among implementing procedures and among organizations.

The governing procedure for the program management element should ensure that the overall CM program is complete, coordinated, and integrated. It should identify the implementing procedures for the program element functions and invoke the other CM program governing procedures. It could also address the overall program model and functions, program scope, program interfaces, and organizational interfaces and responsibilities. Much of this information will have been established by the CM directives and plans; the overall governing procedure provides the top-level procedure for ongoing implementation of the fully-established CM program.

Governing procedures are, in effect, an umbrella document for the implementation process. They can be graphical in nature and take the form of functional flowcharts. Governing procedures in the form of functional flowcharts are also helpful in identifying gaps in procedural links and conflicts between specific implementing procedures. They can also identify decision points and places where quality or management reviews are appropriate. These procedures can also be helpful for configuration management orientation and training.

Figure 2–3 shows the development of the governing procedures in relation to the development of CM policy, plans, and implementing procedures. The governing procedures provide the link between the CM action plan and the implementing procedures.

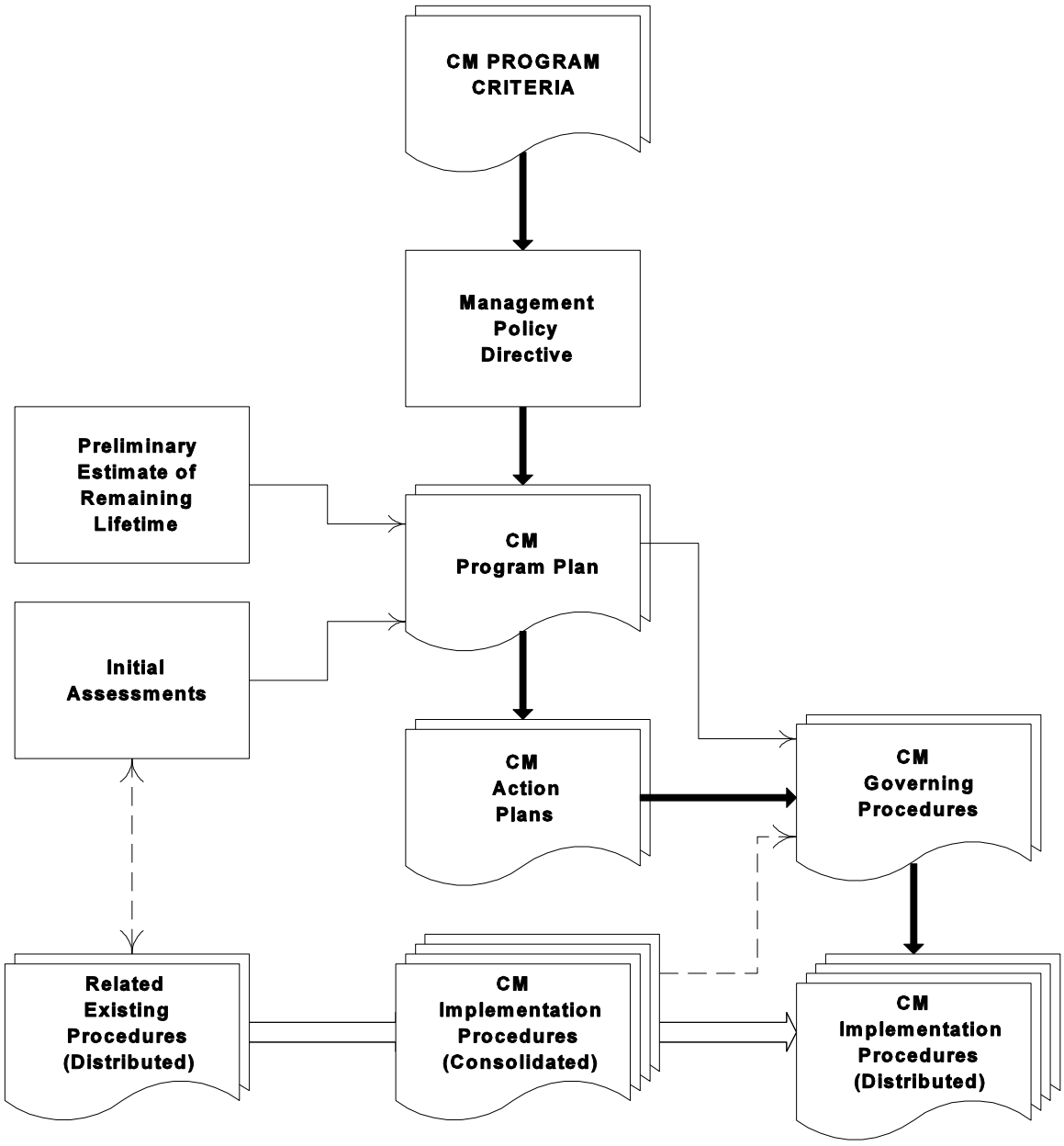

Figure 2-3. Program Management Element: Directives, Plans, and Procedures

2.1.4.3 Implementing Procedures

The program management element should also ensure that appropriate implementing procedures are prepared for each CM program function. In contrast with governing procedures, the implementing procedures provide the detailed instructions for carrying out CM program functions. Implementing procedures are developed for individual program elements as needed. The size of the operating organization influences the need to proceduralize CM activities; the larger the organization and the more numerous the interfaces, the greater the need for procedural controls.

During the initial assessments and program planning, the organization's many existing procedures implementing CM functions will be reviewed to determine If upgrades and enhancement!; are necessary to satisfy the CM program criteria described in Chapter 1. Enhancement and integration of existing implementing procedures within their established organizational structure Is the preferred approach to CM program development and Implementation. It may be necessary or desirable, however, to temporarily consolidate control of implementing procedures in a central CM development organization for purposes of upgrade and integration. During this consolidation phase, it may even be desirable to use the governing procedures to define implementation methods, and later move the implementation methods and requirements to the implementing procedures. On completion of implementing procedure upgrades, the revised implementing procedures would be redistributed to the appropriate implementing organization for ongoing implementation.

2.1.4.4 Configuration Management Training

As policy, plans, and procedures are established, associated training should be provided to communicate expectations and to ensure effective implementation. In addition to standardizing terminology and establishing an integrated system of procedures regarding CM activities, a formal training program in configuration management can be very Important in property orienting facility personnel. The program management element should establish and oversee CM program training activities, including (1) initial awareness or orientation training, (2) follow-up training on development and implementation of the CM program elements and functions, and (3) subsequent refresher training as needed. As defined in the program criteria, training should be provided on CM concepts, terminology, definitions, and procedures.

Training should be started early in the development of a CM program to acquaint users with the new concepts, to ensure a common understanding of the objectives, and to communicate responsibilities for implementing the program (i.e., CM-awareness training). Organizational culture change regarding configuration management is a fundamental part of successful CM program implementation. For example, facility personnel should be able to identify appropriate change mechanisms and always use them. Training, supplemented by clear and documented expectations, and followed up with feedback and coaching, is an effective tool for promoting the culture changes that are needed.

An effective approach to CM training is to provide 1 or 2 days of initial awareness training and then follow-up training as CM procedures are developed and implemented. The initial training should be conducted as early in the CM program development process as practicable, preferably after the site/division CM directive is issued. This training should (1) provide an overview comprising a description of the need, purpose, and management commitment and a definition of the CM program and Its program elements, (2) explain the site/division strategy for developing and implementing the CM program, and (3) identify any interim measures to be adopted until CM program development is complete.

Follow-up training should be conducted as the governing and implementing procedures are written, approved, and issued. The objectives would be to discuss and clarify individual roles, responsibilities,

interfaces, and key activities necessary to fully implement the CM program. The organizational and functional CM flowcharts used in the CM program plan should be retained and used in the training process. Training based on these charts may be started as soon as the concepts have been agreed on and approved by facility management.

Refresher training would be provided periodically (e.g., once a year) for approximately 4 to 8 hours to reinforce the principles of configuration management, to review implemented CM methods, and to advise personnel on any changes In CM tools or practices.

2.1.5 SPECIFIC APPLICATION OF GRADED APPROACH: PROGRAM MANAGEMENT ELEMENT

The size and complexity of the facility indirectly affects the number of SSCs included in the CM program. For example, at a small facility, such as a nuclear hot cell facility, there are not many SSCs. Accordingly, the number of SSCs that can be included in the CM program will be small.

The scope of the SSCs included in the CM program will affect the level of effort involved in every CM program element and function. Facility management could (1) include all facility SSCs within the CM program, (2) limit the scope to some minimum SSCs, or (3) choose a scope between these extremes. At some facilities, it might be appropriate to limit the SSCs to those that provide personnel safety protection. At others, such as nuclear waste tank farms, it might be appropriate to include those SSCs that protect the environment. At other facilities, such as weapons facilities or alternate-energy development facilities, it might be important to include the mission SSCs.

Because the magnitude of the CM program is so strongly influenced by the SSCs included in it, contractor management might find it worthwhile to reevaluate the current classifications of systems within the facilities. Some SSCs that have traditionally been classified as safety-related might not be essential for safety. For example, many nuclear facilities have diesel generators that can provide backup electric power in the event of a loss of normal power. Often, these generators are considered safety-related because they have traditionally been classified that way. In some cases, safety is assured regardless of the performance of the diesel generator. If the accident analysis can demonstrate that an interruption of AC power for a significant period does not lead to unacceptable safety consequences, and normal electric power is likely to be restored within that period, the diesel generator is most likely not essential for safety. In such cases, classification of the diesel generator, could be downgraded.

2.2 DESIGN REQUIREMENTS ELEMENT

As with other CM program elements, much more effort is necessary for initial establishment of this program element than for its maintenance. For many facilities, establishing a complete and accurate set of design requirements can involve more time and resources than any other CM program element. However, this program element is essential because the design requirements are the foundation from which the CM program basic relationships are maintained.

The top-level development flowchart for the design requirements program element is presented in Figure 2–4. Existing design requirements are reviewed to establish the Best Available Design Requirements. As new or revised design requirements are established, this information is fed into the Best Available Design Requirements. Design requirements are correlated with SSCs through the CM equipment database. With the design requirements established, system and component grading can be accomplished. The two key inputs are the equipment scope criteria (from the program management element) and the list of known SSCs. System grading establishes the scope of systems within the CM program and assigns system grades according to the significance of the associated design

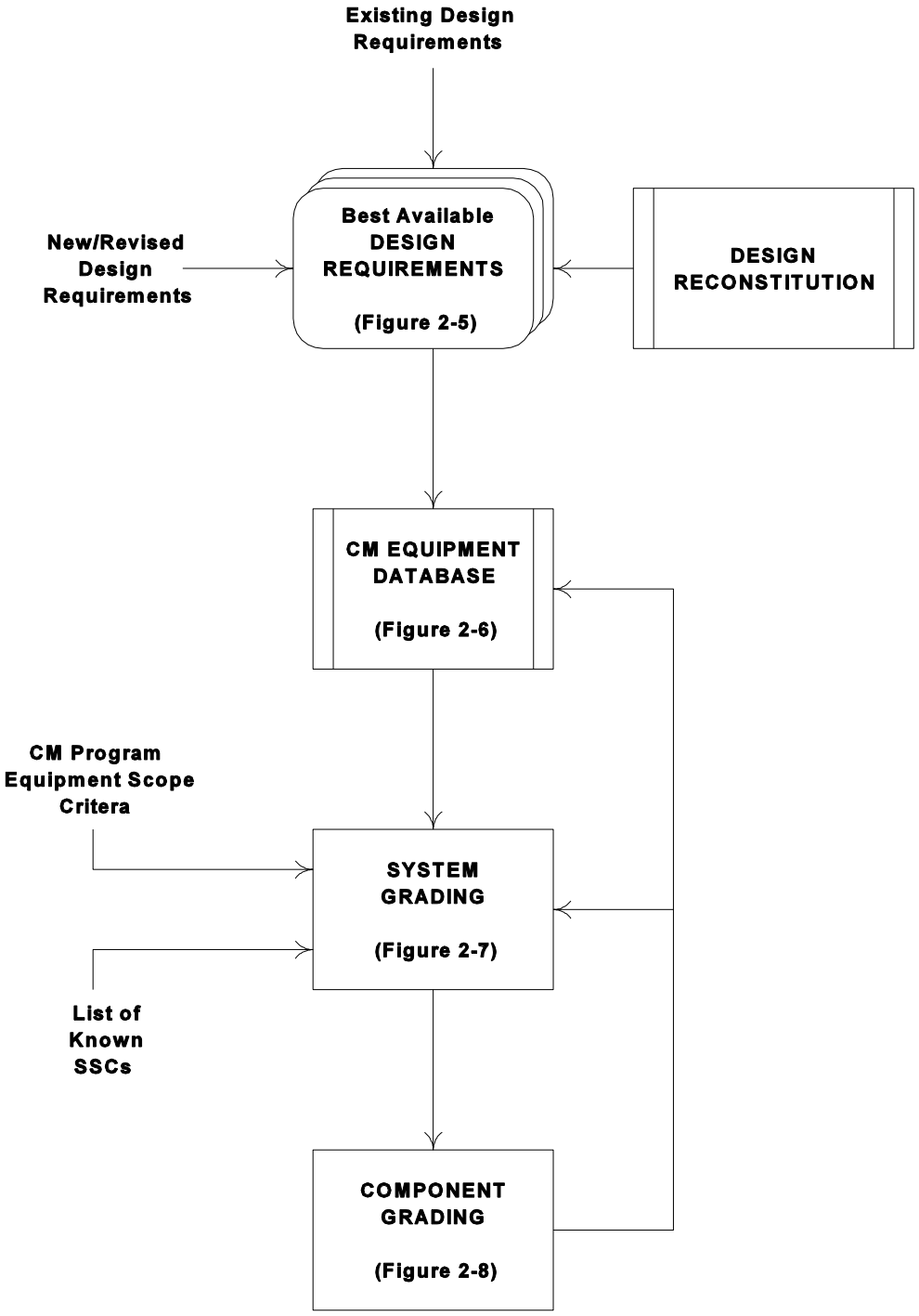

Figure 2-4. Design Requirements Element: Top-Level Development Flowchart

requirements. Component grading continues this SSC grading process at the component level. The component-level grading activity also establish the system boundaries and refines the assignment of components to systems. The SSC grades are fed into the CM equipment database.

2.2.1 ESTABLISHMENT OF DESIGN REQUIREMENTS AND DESIGN BASIS

The top-level flowchart for establishment of the design requirements is presented in Figure 2–5. This process involves the review of existing design requirements, as well as the addition of new and revised design requirements through design reconstitution and the ongoing design process.

Configuration management program criterion 1.3.2.1 states that the design requirements and design basis should be formally established, documents, and maintained. The CM program should identify the various processes and procedures used to establish the design requirements and design basis. For new facilities and physical changes to existing facilities, the program should ensure that procedures are in place that adequately establish the associated design requirements and their design basis, and that document them in a form suitable for use in the CM program. Documentation of the design requirements includes their correlation with associated SSCs and their categorization by type (i.e., safety, environmental, mission, and other). Documentation of the design basis involves its correlation with associated design requirements. Once the design requirements and design basis are established and documented, the CM program should ensure that processes and procedures are in place to maintain them so that they are complete and accurate.

2.2.1.1 Interim Measures for Design Requirements Element

During the development of the CM program plan, the effectiveness of existing programs and procedures is assessed. These initial assessments may Identify cases in which the design requirements and basis were not fully documented, not accurate, or not complete. The following are examples of interim measures that may be needed until development of the design requirements program element is complete:

- Additional controls to ensure that newly generated design requirements and design basis are maintained and available
- Additional procedural guidance on sources of design requirements to ensure that an adequate design envelope review is performed for potential facility changes
- Additional procedural guidance to ensure that designers thoroughly research the existing design basis before issuing new designs
- Additional procedural guidance to ensure that the design process produces a complete set of design requirements and design basis for each new design or design change (See Appendix II–A for more information on various design controls.)
- Actions to prevent the destruction or disposal of source documents containing design requirements and design basis information
- Actions and controls to ensure that the knowledge of experienced engineering and operations personnel regarding facility design requirements and design basis is not lost when they transfer or retire; this includes actions to collect and record design information from personnel who recently transferred, retired, or are near retirement

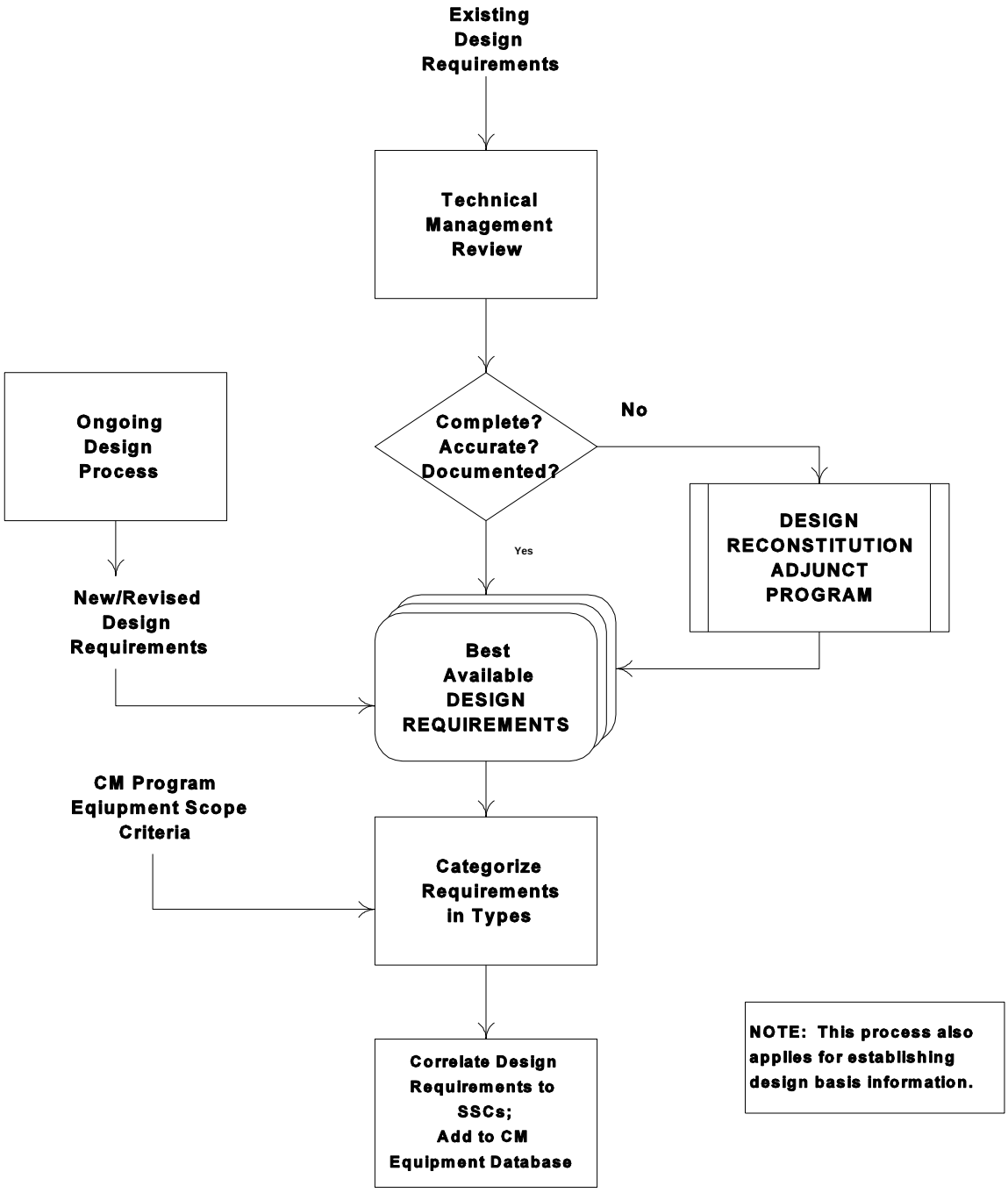

Figure 2-5. Establishment of Design Requirements

2.2.1.2 Design and Construction Turnover

The operational CM program should establish formal criteria for the design and construction turnover of new facilities or new modifications. When an effective interface can be established early in the design process, it is more likely that the needed design products will be provided and turnover can be successful. To ensure effective turnover, the operational CM program should (1) specify the format and content of design basis and design output documents at design inception to ensure that they will be compatible with the CM program needs, (2) periodically monitor the preparation of design basis and design output documents, and (3) provide review and approval of the format and content of final design basis and final design output documents and accept responsibility for their configuration management at turnover.

To ensure a format suitable for use in the operational CM program, the design requirements and design basis should be differentiated, the design requirements should be correlated with the associated SSCs, the design basis should be correlated with the design requirements, the design requirements should be categorized (i.e., safety, environmental, mission, or other), and accurate as-built drawings should be provided. Timely recognition of these interfaces and appropriate coordination will save time and avoid additional costs after turnover.

Although it is highly desirable, it is not always possible for the operational CM program to be involved with the designer/constructor during the design and construction phases. For example, a major new facility might be ordered and designed before final assignment of the M&O contractor. In such a case, the designer should be responsible for ensuring that the operational CM program has the necessary turnover information in a usable form. If the operational CM program is not involved in the design/construction process or if it fails to provide an effective interface, the operational CM program should identify and implement any necessary steps to recover missing information.

As an example, the output of the DOE 4700.1 process, which controls the design for new acquisitions and major physical changes, becomes the input to the operational CM program. If the output is in a form compatible with the needs of the operational CM program, the turnover is acceptable and the operational CM program can maintain the design requirements and their design basis.

2.2.1.3 Technical Management Review of Existing Design Information

With regard to the completeness and accuracy of existing design requirements and design basis, there are many possible cases:

1. Facility design requirements and design basis are fully established, documented in an integrated manner, and maintained so that they are complete and accurate throughout the facility lifetime.

2. Facility design requirements and design basis are established and documented in various and diverse design documents, and they are believed to be generally complete and accurate.

3. Facility design requirements and design basis are established and documented in various and diverse design documents, but their completeness and accuracy cannot be demonstrated.

Case 1 is the desired objective of the CM program. Variations such as the above cases are expected throughout the DOE complex because of such factors as the time frame of initial facility design and construction, the CM practices during initial design and construction, the CM practices during the facility operating life-cycle, and any design reconstitution efforts completed or in process.

As discussed in program criterion 1.3.2.1.b, a technical management review should be performed to determine the adequacy of the facility design requirements and design basis. Judgments of adequacy should be based on completeness, accuracy, and full documentation. The conclusions and the basis for the conclusions regarding the adequacy of the facility design requirements and design basis should be documented in the facility CM program plan. If the conclusion is that the design requirements and their design basis are not fully documented, not complete, or not accurate, then they should be reconstituted to the extent called for by the design reconstitution adjunct program.

This technical management review should identify the actions necessary to evaluate the current status of facility design requirements and design basis. It should consider the results of applicable assessments, especially the initial CM assessments. The completeness and accuracy of the facility design requirements and basis is one of the most significant areas to be evaluated during the initial assessments. By correlating the design basis with the design requirements and the design requirements with the physical configuration and facility documentation, the vertical slice assessment can provide unique insights into the completeness and accuracy of existing design requirements and basis, as well as into the effectiveness of past and present CM practices.

If the initial assessments support a definitive conclusion regarding the adequacy of the facility design requirement and design basis, no further activities may be necessary other than a review of the assessment results by technical management. However, if the initial assessments do not support a definitive conclusion, the management review should identify additional actions to supplement the findings of the initial assessments. The technical management review should include technical managers having broad design backgrounds and experience and representing the various design disciplines. Several different approaches to this review are possible. Whichever approach or combination of approaches is chosen, it should focus on whether any design information is missing.

The technical management review process may include the following methods of assessing completeness:

- Comparisons with industry codes and standards that identify expected design information
- Comparisons of like design requirements for comparable components
- Comparisons of like design basis for comparable design requirements
- Review of design information to identify SSCs with missing or incomplete information
- Review of open items and discrepancies that have not been resolved
- Review by independent, external, technical experts

In conjunction with the approaches listed above, a template approach may be used. A generic template is prepared to identify the types of design requirements and design basis typical for a given SSC type. The template is comprehensive and includes both the expected and possible design requirements and design basis. The design requirements and design basis would be compared with the template to identify missing requirements and design basis. For example, a template for piping might check for design requirements such as basic flow diagrams, layout and arrangement diagrams, isometric diagrams, support detail, material specification, testing requirements, and many other items. For the design basis, the template for piping might check for pipe sizing/flow analysis, minimum wall thickness evaluations, corrosion/erosion allowances, American Society of Mechanical Engineers (ASME) code conformance, DOE commitments, system interface input requirements, design procedure documentation, and many other items. Other examples of design requirement and design basis information that could be appropriate for the templates are presented in Appendix II–B.

Inaccurate design requirements and design basis can be identified by discovering conflicting documentation, a conflicting physical configuration, or errors (in calculation, for example) in the design basis. To assess accuracy, the management review could employ some combination of the following methods:

- Checks of reasonableness by competent design personnel
- Checks to determine whether the design requirements apply to current physical configuration
- Reperformance of critical calculations and analysis independently or with different methods

The facility design requirements should be documented in a retrievable, user-friendly manner. The relevant design information should be identified by system and an index of design documents should be provided. To determine whether the design is fully documented, the management review should consider whether: the design information is clearly identified; the design requirements are differentiated from the design basis; safety, environmental, and mission design requirements are differentiated from other types of design requirements; and the design documentation is indexed, integrated, and usable. Objectives for the documentation of design information are provided in Chapter 3.

If design reconstitution is warranted, the management review should develop recommendations as to the extent of design reconstitution needed and the associated priority.

2.2.1.4 System Design Descriptions

The CM program and engineering management may decide to prepare system design descriptions (SDDs) to collect and summarize existing design requirements for each system and topical area. The SDDs would help facility personnel understand system functions and requirements. They would include system drawings and a system description, as well as descriptions of functional process requirements, system and component design requirements, system interfaces and interlocks, setpoints, and design requirements related to operations, maintenance, and testing. The SDDs could be predecessors of the design information summaries (DISs) prepared by the DR adjunct program. They should be prepared in a format convenient for adoption into the DISs that will be developed later. DOE Standard NE F 1-2T, *Preparation of Plant and System Design Description Documents*, provides information on documenting design requirements.

2.2.1.5 Configuration Management Equipment Database

The CM equipment database should be established to cross-reference the CM program SSCs with their design requirements, design basis, and associated documents. This database is the primary information source for design requirements. It should use the Best Available Design Information to fill the database fields. This Best Available Design Information comes from three basic sources: (1) existing design information, (2) new or revised design information, and (3) reconstituted design information.

Computer databases can effectively and efficiently support the design requirements element, serve many users, and advance configuration management. Computer database development should maintain focus on achieving the associated CM program elements and functions. The program management element provides general direction, including general contents, for CM databases. Given the extent of the contents, relational databases will likely be most effective, as they can relate records in one file to records in many other files. For example, the equipment database should be able to identify the SSCs involved in the fire protection program.

The CM equipment database should contain and correlate the following information:

- System designators
- Component designators
- Component descriptive information such as type, manufacturer, model, and size
- Design requirement types applicable
- SSC grade (based on the most Important design requirement applicable)
- Design requirements or, at a minimum, references to them
- Design basis references
- Design topical area references (e.g., seismic, environmental qualification, fire protection)
- Facility document references (e.g., drawings, procedures, Safety Analysis Report (SAR) and Technical Safety Requirement (TSR) sections)
- Other desired system and component information

A simplified sample format for a basic CM equipment database is provided as Figure 2–6. The actual format, contents, and capabilities of an organization's CM equipment database will depend greatly on the identified needs and intended uses.

As part of the establishment of design requirements, each SSC within the CM program should be assigned a unique identifier, if one has not already been assigned. Unique identifiers that incorporate system designators, component type, and numbers (e.g., SW-MOV-91) are more useful than strictly numeric identifiers (e.g., 1357111317). The component identifiers should correspond to the labeling of equipment for physical configuration. Unique identifiers and equipment labels are important for helping maintain the CM program basic relationships and for supporting equipment operations. Operational aspects of equipment designation and labeling are discussed in DOE 5480.19, *Conduct of Operations Requirements for DOE Facilities.*

A database owner should be assigned, with roles and responsibilities established. As most of the information is design information, the design authority is a likely choice. As such, the design authority would be the focal point for resolving discrepancies and updating the database. Other organizations should use the CM equipment database as their primary source for SSC design information.

Information necessary to complete certain facility document reference fields will likely come from personnel coordinating implementation of the document control program element. The purpose of these facility document references is to support identification of the affected documents when design changes are made. The design authority can be expected to complete the document references that relate to design information -- either design requirements or design basis. However, other organizations will be assigned ownership of other documents important to configuration management (e.g., as-built drawings; operations, maintenance, and testing procedures; SARs and TSRS). A central document control organization may support completion of the affected database fields by coordinating database input for nondesign documents and ensuring the ongoing integrity of that information.

2.2.1.6 Design Reconstitution Interface

The DR adjunct program, if pursued, contributes to the Best Available Design Information. The verified and validated results of these efforts should be entered into the CM equipment database. Further, these results should be reviewed for their impact on system and component grading while they are being entered into the database. If design reconstitution is necessary, certain DR program actions, such as the formal review of on-hand design documents, should be considered for prompt initiation to support development of the design requirements element. For major design changes, it may also be desirable to accelerate design reconstitution on selected systems and components. Implementation guidance for design reconstitution is provided in Chapter 3.

SSC System	SSC Component	Descriptive Information				Safety Design Rqmts.	Environmental Design Rqmts.	Mission Design Rqmts.	Other Design Rqmts.	SSC Grade	Design Rqmts. References	Design Basis References	Seismic Program	EQ Program	Fire Protection Program
System 1	Comp. 1	•	•	•	•	✓	✓	✓	✓	S	Ref1, Ref2, •.•.•	Ref1, Ref2, •.•.•	✓	✓	✓
System 1	Comp. 2	•	•	•	•		✓		✓	E	Ref1, Ref2, •.•.•	Ref1, Ref2, •.•.•		✓	
System 1	Comp. 3	•	•	•	•			✓	✓	M	Ref1, Ref2, •.•.•	Ref1, Ref2, •.•.•			✓
•	•	•	•	•	•	✓				S	Ref1, Ref2, •.•.•	Ref1, Ref2, •.•.•	✓	✓	
•	•	•	•	•	•		✓			E	Ref1, Ref2, •.•.•	Ref1, Ref2, •.•.•			
•	•	•	•	•	•			✓	✓	M	Ref1, Ref2, •.•.•	Ref1, Ref2, •.•.•			
System 1	Comp. M	•	•	•	•				✓	O	Ref1, Ref2, •.•.•	Ref1, Ref2, •.•.•			
System 2	Comp. 1	•	•	•	•		✓	✓		E	Ref1, Ref2, •.•.•	Ref1, Ref2, •.•.•	✓	✓	✓
System 2	Comp. 2	•	•	•	•	✓		✓	✓	S	Ref1, Ref2, •.•.•	Ref1, Ref2, •.•.•	✓	✓	✓
System 2	Comp. 3	•	•	•	•				✓	O	Ref1, Ref2, •.•.•	Ref1, Ref2, •.•.•	✓	✓	✓
•	•	•	•	•	•		✓			E	Ref1, Ref2, •.•.•	Ref1, Ref2, •.•.•			
•	•	•	•	•	•			✓	✓	M	Ref1, Ref2, •.•.•	Ref1, Ref2, •.•.•			
•	•	•	•	•	•	✓				S	Ref1, Ref2, •.•.•	Ref1, Ref2, •.•.•		✓	
System 2	Comp. M	•	•	•	•	✓			✓	S	Ref1, Ref2, •.•.•	Ref1, Ref2, •.•.•			✓
•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•

Figure 2–6. Design Requirements Element: CM Equipment Database

2.2.2 ASSIGNMENT OF SSC GRADES

The grading of SSCs can be performed efficiently by separating system and component grading. The systems are graded first the components to systems and graded next. This approach to grading calls for increasing levels of design requirements knowledge as the grading proceeds to the component level. For example, it might be obvious that a given system is related to safety, but less obvious that a given component within that system has a safety function.

2.2.2.1 System-Level Grading

Facility structures may be categorized as either systems or components, whichever makes the most sense for the facility. The facility may choose to address structures collectively as a single overall system and address individual structures as components. Alternatively, individual structures may be associated with the systems they house and support. Similarly, computers and software important to facility operation should be evaluated as either systems or components, as appropriate.

A flowchart showing the basic steps for system-level grading is presented as Figure 2–7. The initial step of system grading is to identify the facility systems. System designations already exist at most facilities. If such designations do not exist, the components that accomplish the same basic facility functions and processes should be grouped into systems.

The second step is to identify the types of design requirements that apply to each system according to the best information on the design requirements available. (The specific criteria for each requirement type will have been established during program planning.) For the Initial system grading, experienced personnel with key design documents on hand are capable of applying their design knowledge to make this determination quickly and accurately. Such summary design references include the facility SAR, the TSR, SDDs, fire protection analyses, criticality evaluations, and any other readily available general and summary design documents deemed appropriate by experienced personnel. Later, as design requirements are formally reconstituted, the Best Available Design Information might indicate a need to refine these determinations.

The next step is to assign a system grade according to the types of design requirements that apply to each system. The grade is based on the most important category of design requirements that applies. For example, if a system has safety design requirements, it is a safety system. If it has mission design requirements and neither safety nor environmental requirements, it is a mission system. For example, a facility life-limiting component, as identified by the material condition and aging (MCA) adjunct program, would be graded as mission if no higher grade applied.

2.2.2.2 SSC Inclusion In Configuration Management Program

Finally, the facility CM program equipment scope criteria are applied to determine which systems will be included in the CM program. (These criteria should have been established by the program management element equipment scope criteria function and documented in policy directives and the CM program plan.) For example, the equipment scope criteria may be such that only safety, environmental, and mission SSCs are within scope, in which case the optional systems are out of scope and no further action is necessary for these systems. A facility may elect to include none, some, or all of the optional systems. As another example, if only the safety SSCs were within the scope, the other systems would not be included in the CM program.

New information relevant to system grading will be identified periodically in ongoing CM program development and implementation as well as normal design and operations activities. This includes the preparation of new designs. For example, the facility might add a new system that needs grading.

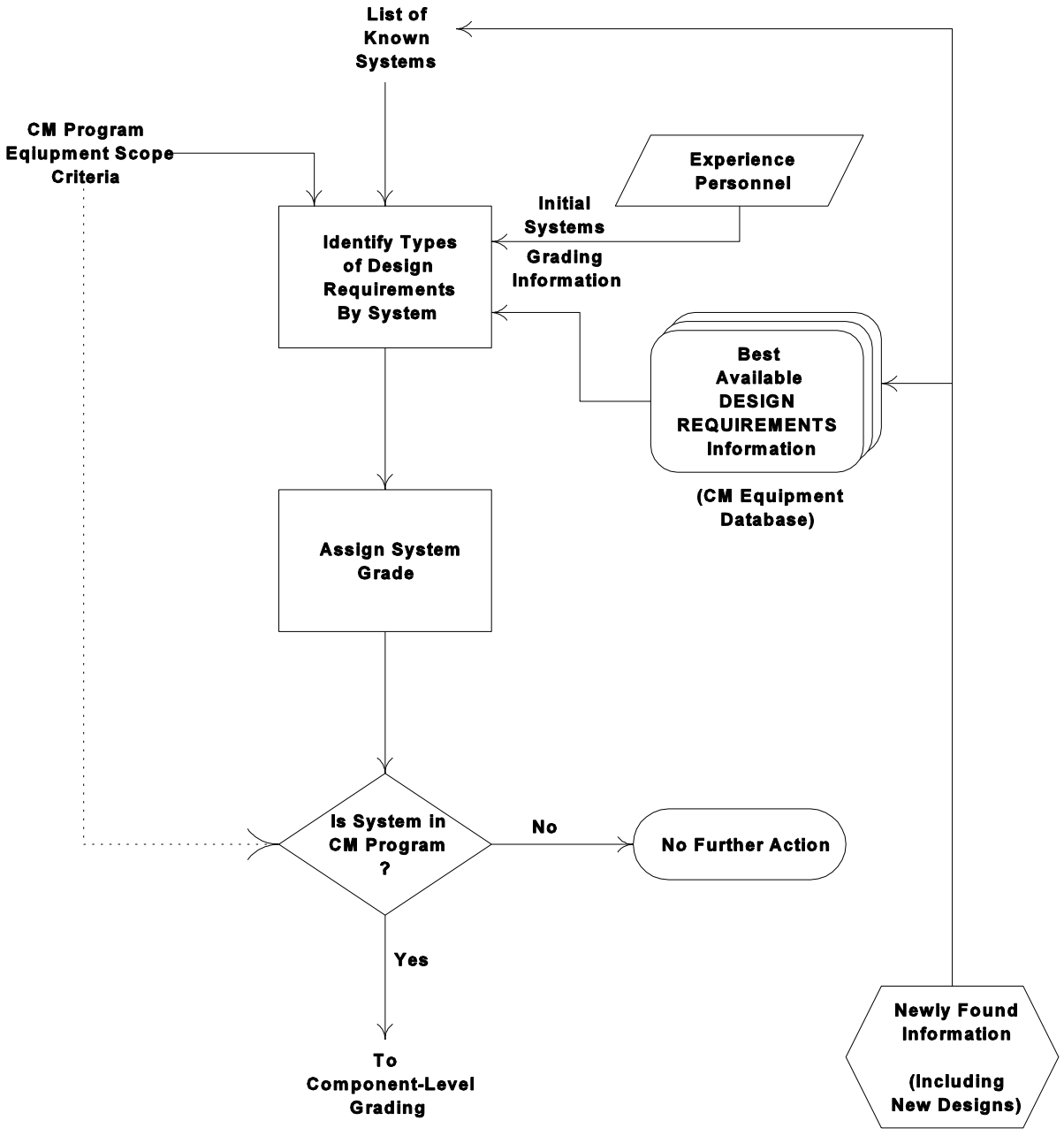

Figure 2-7. Design Requirements Element: Assignment of System-Level Grades

Further, the DR adjunct program might uncover facility design requirements that affect system grading. The impact on system grading should be considered for any newly found information. While system grading is generally a one-time activity, it is reviewed and revised, as necessary, when new information becomes available.

2.2.2.3 Component-Level Grading

The scope of component grading is much greater than that of system grading because of the much greater number of components. However, the grading process is analogous. In addition to assigning grades, this activity also formally establishes the detailed system boundaries and refines the assignment of components to systems.

Component grading should not be attempted until there is a fairly complete set of design requirements and thus the necessary level of detail. Initial component-related activities should focus on establishing system boundaries and assigning components to systems. Initial or default component grades equivalent to the associated system grade may be assigned until the design requirements information is complete. If design reconstitution is necessary, the formal review of on-hand design information documents should be completed fairly early to facilitate component grading. A flowchart for component-level grading is presented as Figure 2–8.

List of SSCs. A complete list of facility components is essential if all possible SSCs are to be considered for inclusion within the CM program. Existing configuration information in the form of a Master Equipment List (MEL), required by DOE 4330.4A, *Maintenance Management Program,* or the equivalent may be an adequate starting point for component evaluation. The initial CM program assessments will examine the need for facility walkdowns to establish accurate facility drawings and equipment lists. The CM program plan will reflect the results of these initial assessments. If comprehensive walkdowns are not necessary and the component lists are essentially complete, system boundary evaluation and component grading can proceed. However, if walkdowns or other activities are needed to define a complete list of facility components, they will have to be coordinated with component grading. The validated MEL should be combined with CM equipment data to form a single, complete equipment list for the facility, contained in the CM equipment database, that will satisfy all data owners and users.

The first several steps shown in Figure 2–8 identify the scope of components that need grading. Known components should be sorted into systems with other components that have the same basic functions and processes or are located or connected together. Only systems that meet the CM program equipment scope criteria need to be considered during the component-level grading activity. The next step refines the system boundaries. Components are already assigned to systems at most facilities. Following the refinement of system boundaries, it may be necessary to adjust the assignment of components to systems.

System Boundaries. Facilities should carefully evaluate and define system boundaries. Systems should contain those components that are necessary to fulfill the system's design requirements (e.g., the functional and performance requirements). Design codes and standards often identify reasonable and natural system boundaries. The following system interface considerations may apply to system boundary evaluation:

- Location of piping class breaks
- Location of isolation valves
- Location of seismic class breaks
- Location of test features
- Supporting features and functions

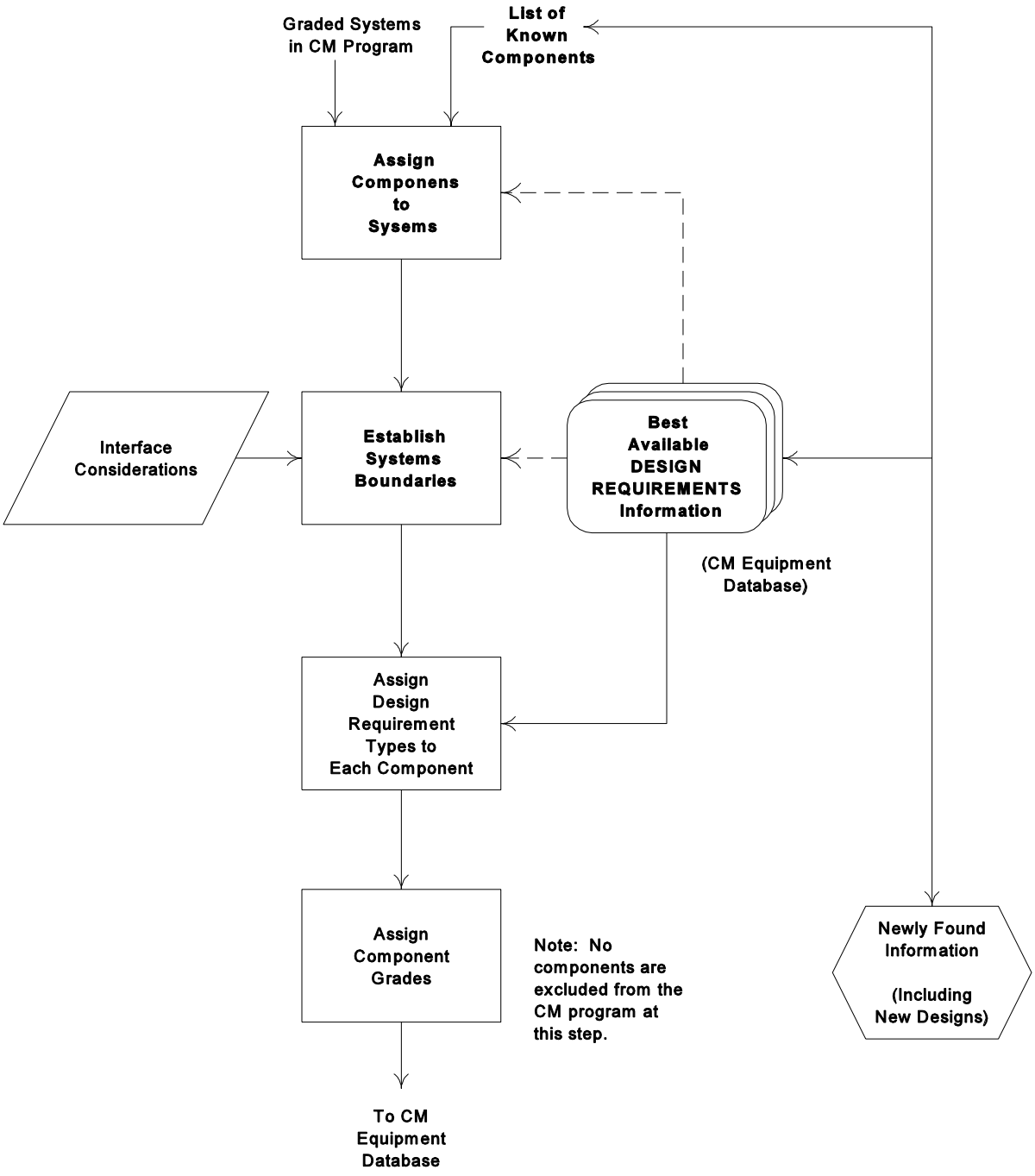

Figure 2-8. Design Requirements Element: Assignment of Component-Level Grades

In establishing boundaries between facility systems and essential supporting systems, arbitrary but reasonable boundaries may be defined. Essential support services include electric and control power, instrument air, lubricating oil, and ventilation.

There are two primary approaches, one recommended and one alternate, for establishing system boundaries for essential support systems. The recommended approach is to extend the safety system boundaries to include essential support items out to an appropriate interface, such as an isolation valve. The alternate approach Is to deem the essential support systems to have safety portions. According to the recommended approach for air-operated equipment, the air controller, solenoid switches, and air isolation valves would be considered part of the basic safety system, while equipment upstream of the valve would be considered part of the instrument air system. According to the same approach for electrically operated equipment, the electrical components, including limit switches, out to and including the first breaker, would be considered part of the basic safety system, and the components upstream of the breaker would be considered part of the electric power system.

Assignment of Component Grades. Component grades should be assigned in a manner analogous to system grading. Best Available Design Information should be used to identify the design requirements associated with each component and determine the design requirement types associated with each component. In some cases, the design requirements might indicate that a component is not essential to the system's top-level function. For example, a safety cooling-water system might have a chemical release monitor with an environmental design function, but no safety design function. Component grades should be assigned on the basis of the applicable types of design requirements. The component grade should be based on the most important type of applicable design requirements.

As previously stated, the default component grade is the same as the system grade. In many cases, the component is graded consistently with its system. The net result of component grading may be the downgrading of certain components that are not essential to the top-level category of design requirements for the system. For example, local instrumentation to support maintenance might not be needed to fulfill either safety, environmental or mission requirements. If there is any doubt with regard to downgrading a component, the component should retain the system grade until associated design requirements are fully reconstituted. If a component appears to have design requirements of a higher grade than its system, the system might be incorrectly graded or the component might be in the wrong system.

With the exception of components whose design requirements have been established and found to be adequate and outside the equipment scope criteria, all components within a CM system should be included in the CM program, even those without a safety, environmental, or mission function. Once the design requirements are fully established and adequate, the CM equipment scope criteria may be used to consider component exclusions. However, the inclusion of components other than safety, environment, and mission ones is generally advisable for CM systems to enhance overall configuration control.

As with system grading activities, other ongoing activities will periodically identify new information relevant to component grading. New design activity, for example, might add new systems as well as new components to existing systems. The DR adjunct program might uncover facility design requirements that affect component grading. Moreover, system walkdowns or operational activities might identify previously overlooked components. The impact of new information on component grading should be taken into consideration. While component grading is generally a one-time activity, its results are subject to review and revision as necessary when new information becomes available.

2.2.3 FULLY DEVELOPED ELEMENT

A schematic for the fully developed design requirements element and its program interfaces is presented as Figure 2–9. The design process can be initiated through change control processes that involve requests for a wide range of engineering design support - from major permanent facility physical changes to engineering evaluations for adjusting operations setpoints or revising maintenance and testing requirements. Requests for engineering design typically include a description of the problem and sometimes include a requested or proposed facility change. This information contributes to the design inputs for the design process.

After the design process establishes new or revised design requirements and their basis, the approved design requirements are processed through the change control processes necessary to authorize, implement, test, and document physical changes in the facility or changes in facility documentation. When a design change affects neither the physical configuration of the facility nor facility documentation, the approved design output documents may go directly to the document control program element for a records update and distribution as appropriate. An example of this type of design change would be a design reanalysis that discloses the need for a reduction in heat exchange capacity from 88 to 80 percent. Design basis documentation may also be forwarded to document control for storage and future retrieval. Revisions to the design requirements that affect the assessments element should provide appropriate review and for execution of the various assessments element functions. For example, a design change might specify in-service testing or post-modification testing requirements. Additionally, design requirements might specify periodic monitoring criteria and methods.

2.2.4 SPECIFIC APPLICATION OF GRADED APPROACH: DESIGN REQUIREMENTS ELEMENT

With respect to the establishment of the design requirements and design basis, a distinction is made between new work and reconstitution. Design requirements and design basis should be developed for new design work. For the reconstitution process of retrieving and regenerating existing design requirements and design basis, these functions should be adjusted according to a graded approach, as described in Chapter 3.

2.3 DOCUMENT CONTROL ELEMENT

Development of the document control element is discussed below in two stages: the initial development activities and the fully developed program element. The initial development activities include those actions necessary to identify and evaluate the existing population of documents and document processes. The fully developed program element comprises the activities involved in ongoing, steady-state document control.

2.3.1 INITIAL DEVELOPMENT ACTIVITIES

Initial development of the document control element is depicted in Figure 2–10.

2.3.1.1 Identification of Documents To Be Included In CM Program

Early in CM program development, a determination should be made as to which documents will be included. The steps necessary to accomplish this are as follows:

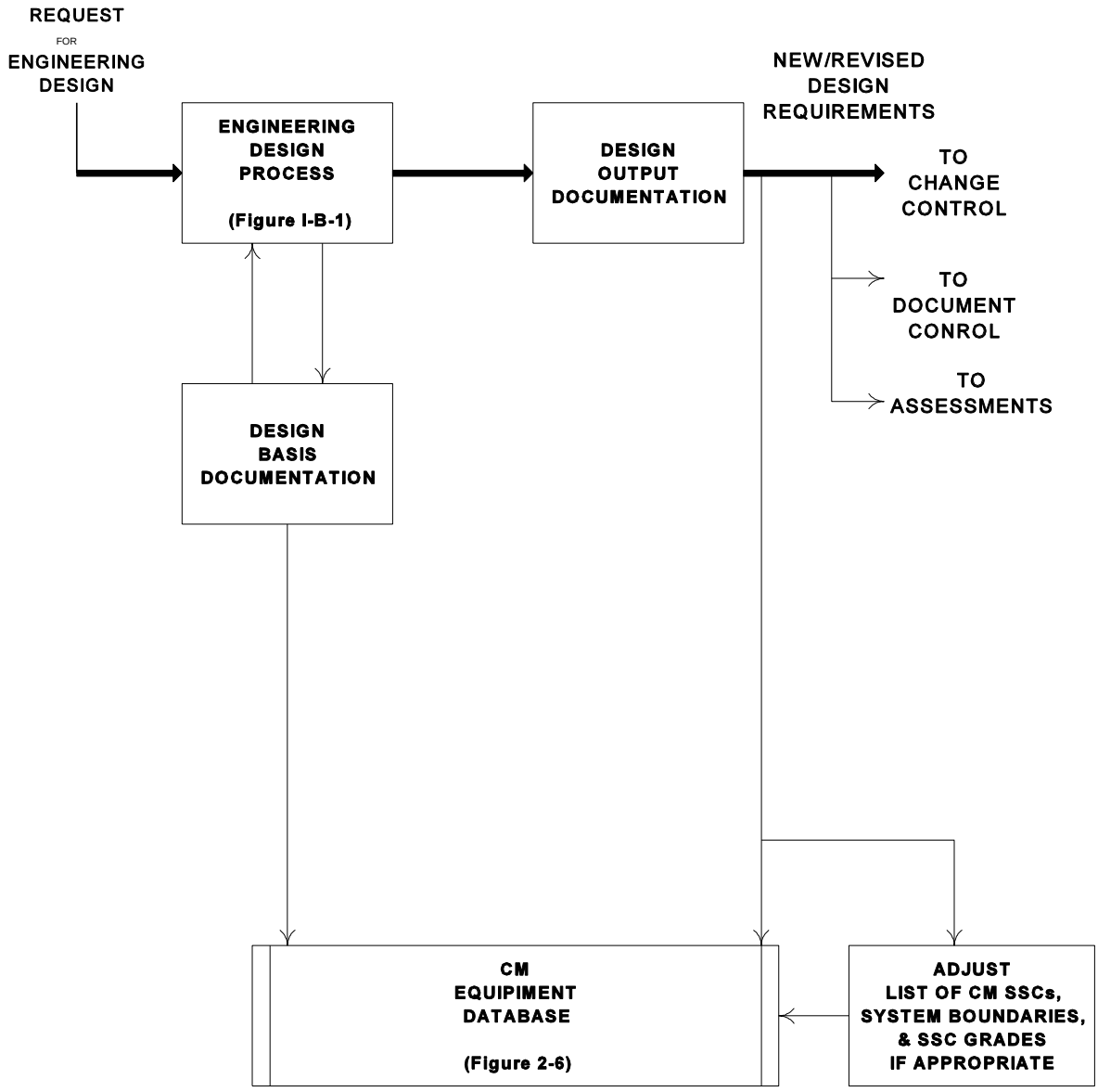

Figure 2-9. Interfaces with the Fully Developed Design Requirements Element

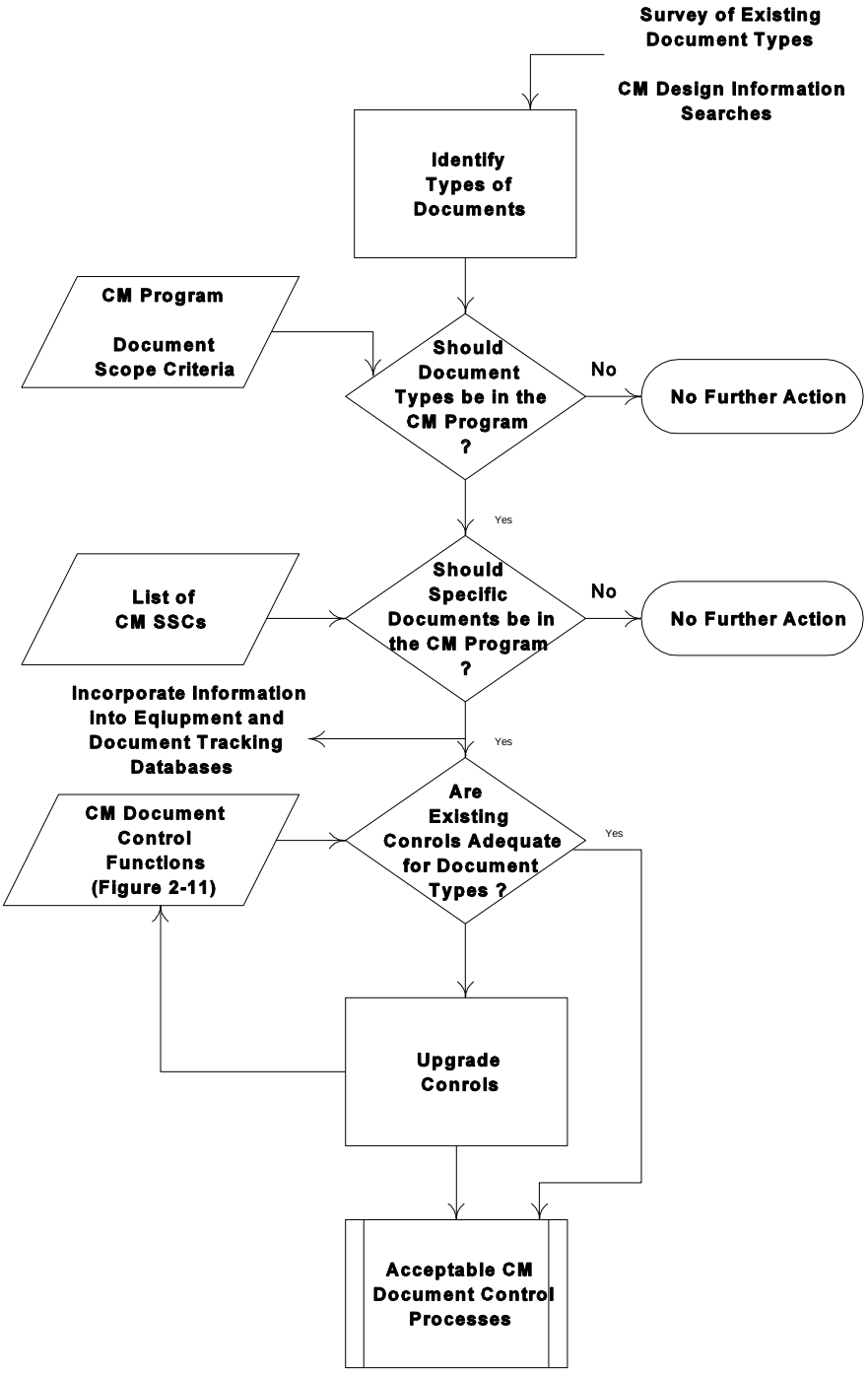

Figure 2-10. Document Control Element: Top-Level Development Flowchart

- Identify document types used at the facility.
- Determine which document types should be in the CM program.
- Determine which specific documents should be in the CM program.

First, a complete survey of document types in use should be conducted with support of the various organizations at the facility. Each organization should identify the document types it prepares and the important document types it uses. Document types identified during the initial assessments should also be addressed.

After document types are identified, a document owner should be assigned to each document type. The natural document owner is the person or organization responsible for developing and revising the technical content of documents within the assigned document type. The owners should review the document types for which they are responsible to identify those important for supporting the CM program objective and criteria. They should then perform an importance evaluation In light of their experience with, and knowledge of, the document types. Document scope criteria may vary according to the importance of the SSCs involved. These criteria should be defined to include only those document types that support the design or operation of facility SSCs included In the CM program. Document types that reflect the facility's design requirements and those that are necessary for day-to-day operation should receive the highest priority for inclusion in the CM program.

Finally, the document owners, with the assistance of those persons responsible for the document retrieval function, should identify the individual documents within each document type and determine which of these documents should be included in the CM program. To accomplish this, a determination should be made as to whether that document supports an SSC that is included in the CM program. The CM program equipment scope criteria and the specific list of SSCs within the CM program, if available, should be provided to the document owners for support in their evaluation. For example, if Quality Receipt Inspections were a document type to be included in the CM program, it would not be necessary to include inspections that pertain to equipment not included in the program. The intent is to include only those documents necessary to support configuration management. Documents specifying requirements for day-to-day operations (e.g., procedures, drawings, vendor-supplied documents) and those necessary for modifying the facility (e.g., design requirements, design calculations, accident analyses) should be Included. If there is any doubt, the document should be included in the CM program. It may be advantageous to coordinate this activity with the design reconstitution document searches described in Section 3.2.

After identification of the specific documents for inclusion in the CM program, the following information on each document should be recorded in the document databases to facilitate tracking and control: document type, unique document number, and document uses and priority. This information should be retained. Selected document information (e.g., SSC-specific drawings, procedures, and vendor information) should also be entered into the CM equipment database to establish a cross-reference or link between SSCs within the CM program and the associated documents.

2.3.1.2 Review and Upgrade of Existing Document Control Processes

For each document type to be included in the CM program, the adequacy of the existing document control process should be evaluated against each of the basic document control functions. A survey of existing document control processes should be conducted to identify the process that either identifies, stores, controls, tracks, or retrieves the included document types. After the document control element is developed, documents within the CM program should be processed in a manner consistent with the model shown in Figure 2–11, as discussed in more detail in Section 2.3.2.

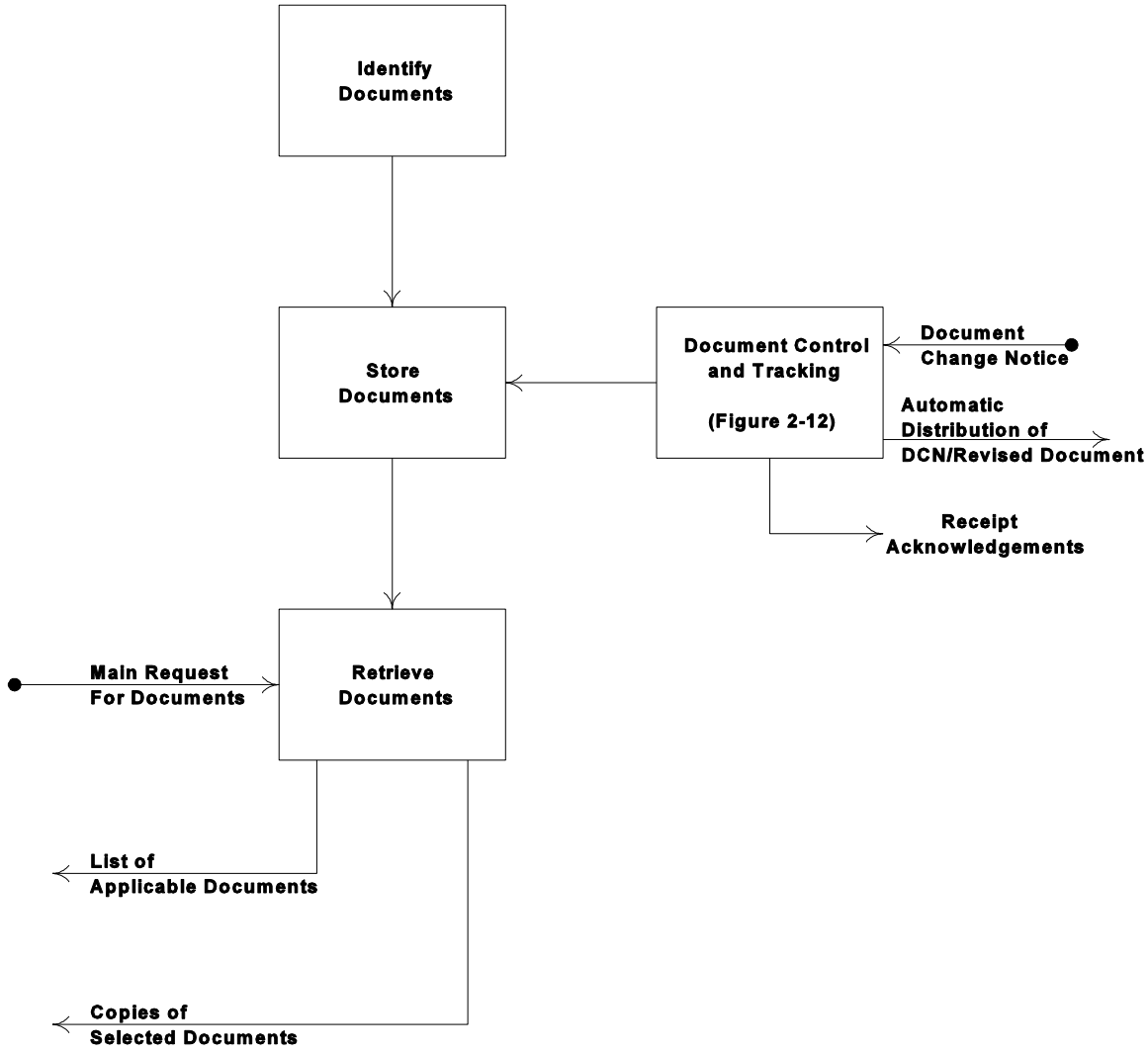

Figure 2-11. Document Control Element: Document Control Functions

Each identified document control process should be reviewed against the expectations for the fully developed program. Deficient document control processes should be upgraded as necessary. For example, if piping and instrument drawings (P&IDs) are to be included in the CM document control element and it is determined that little formal control exists, the existing P&ID document control process should be enhanced consistent with the requirements established by the CM document control element. Various document control processes may also need to be consolidated to provide a consistent, reliable approach. A centralized document control process is often the most efficient and effective, particularly for the storage, tracking, and retrieval functions. A centralized approach should include satellite document distribution stations if needed for user support.

The establishment of an effective document database should begin during the initial development stage. As discussed in connection with the program management element, this involves a review of existing databases, consolidation and upgrades as necessary, and the addition of any missing document data. The document database is integral to the control and tracking function and the retrieval function of this program element.

2.3.2 FULLY DEVELOPED ELEMENT

The following discussion presents recommended methods for and features of the basic document control functions reflected in Figure 2–11.

2.3.2.1 Identification of Documents

The process for evaluating newly identified documents is similar to that outlined in Section 2.3.1. As new documents are generated, they should be reviewed for inclusion into the CM program. To accomplish this, the document owner determines if the new document supports an SSC within the CM program or satisfies other scope criteria established for inclusion.

Once included, the document owner should categorize the new documents according to document type and identify their uses and establish importance to users. Either the document owner or document control organization should uniquely number each document and prioritize that document consistent with its importance. The appropriate data on the document should be entered into the document database with the appropriate data fields completed.

New types of documents may also emerge and have to be identified for inclusion in the CM program. The identification of new document types for inclusion into the CM program should be considered whenever new document types are established.

2.3.2.2 Storage of Documents

The objective of temporary and long-term storage facilities is to preclude damage or loss from deterioration, larceny, or vandalism. Methods of storage should be based on the particular characteristics of the document. Special consideration should be given to light-, pressure-, or temperature-sensitive documents (e.g., radiographs, photographs, film) consistent with applicable industry standards. Responsibilities should be assigned to ensure that records (active and inactive) and other documents are protected, preserved, and stored such that they can be retrieved within defined retrieval times. For example, a central document control organization may be assigned storage responsibilities.

Storage and retention of documents should be in accordance with DOE Orders, specific commitments to DOE, national standards, and the needs of the document owners and users. Many of these storage

and retention requirements are already established and in place. The document owners may specify retention times longer - but not shorter - than the minimums specified by DOE 1324.2A, *Records Disposition.*

2.3.2.3 Control and Tracking

Figure 2–12 supplements Figure 2–11 by providing more detail on the process used to control and track documents. Control features aim primarily at ensuring that only the currently-approved revisions of documents are in use. Tracking features support this aim through the maintenance of information on the current status of documents and the provision of information on pending changes. The major features for the effective control and tracking of documents within the CM program are discussed below.

Control Procedures. Procedures specifying the document identification, control, storage, and retrieval requirements should be developed and implemented to ensure consistency in, and to facilitate management of, the document control program. These procedures should establish responsibilities and, methods for each document control function. Document change notices (DCNs) should be used for the notification of document changes.

Secure File. A secure master file of the original documents or master copies should be established and maintained. The master copies should not be released from that file; only reproductions should be provided, either on a regular distribution schedule or in response to specific requests. Strict controls should be established for the viewing of master copies. Access and security precautions should be established to ensure that the document master file is controlled and kept current.

Controlled Document Distribution List. A controlled document distribution list should be established and maintained. That list should Identify both the documents that are to be controlled and the holders of copies of those documents. Users of documents should identify their document needs to the document owners, who should determine the users to be included on the controlled document list. The distribution list should include any satellite document distribution centers.

Identification of Proposed Changes. The document control organization should be notified of any need to change a document as soon as that need is identified and approved. A DCN may be used for this purpose. The document control organization, in turn, should provide a receipt acknowledgement of such a notice to the originator. The document control organization should update the document status in the document database.

Notification of Pending Changes. Pending changes are those changes for which conceptual design has been approved and the design change is in process, those changes that have been approved for implementation, or those approved unincorporated changes that have been implemented in the field, but for which the document revision has not been completed. The document control organization should provide notice of pending changes to the persons on the controlled distribution list for the document involved. A notice of the pending change should also be attached to, or appropriately referenced on, the affected master document, in order to alert anyone requesting a copy of the document.

Timely Incorporation of Changes. After the actual document changes are defined and are approved by the document owner, the changes should be incorporated onto the document master copy in a timely manner. The backlog of unincorporated changes should be controlled. Consideration should be given to incorporating small changes in batches. On the other hand, a large backlog of unincorporated changes adversely affects the value and usability of the documents. The number of unincorporated changes should be limited by establishing a threshold to trigger the incorporation of the outstanding

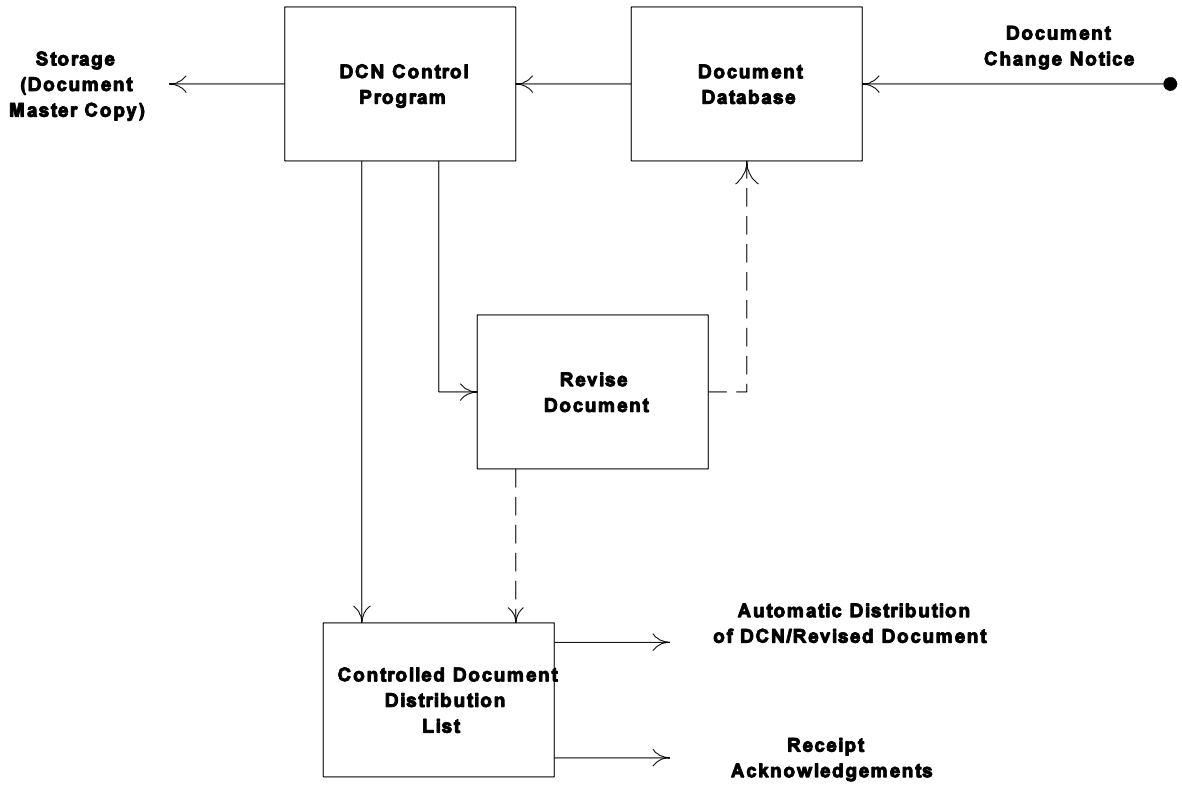

Figure 2-12. Document Control Element: Document Control and Tracking

changes for that document. The threshold level should depend upon the type of document, document priority, complexity of the changes, and the degree of overlap of those changes. For example, using such a threshold approach, the number of unincorporated drawing changes could be allowed to reach two to five changes per drawing before the changes were actually incorporated on the document. The document owners should also periodically monitor the incorporation of changes to ensure that the threshold levels are effective.

Distribution of Documents. When a controlled document is issued or revised, copies should be automatically sent to those on the distribution list associated with the document, along with a request for written receipt acknowledgment. A receipt acknowledgement form may be used. Timeliness guidelines for distribution of documents should also be established. In some cases, prior to the formal document distribution, the most important documents, such as control room drawings are posted within 24 hours. Less important ones are posted within 72 hours. The least important ones are posted within 7 days. The recipients should update their copy of the document (for example, by inserting changed pages), and discard any obsolete pages or copies of documents. The recipient should then return written receipt acknowledgment to the document control organization. The controlled copies in use should be periodically reviewed to ensure their accuracy and their consistency with the master copies.

Control of Superseded or Cancelled Documents. The document control process should include measures to ensure that superseded or canceled documents are replaced. ff a copy of a superseded or canceled document is requested, that copy should be clearly and distinctively marked as such.

Document Database. A database should be provided for use in tracking document status and pending changes. This database should contain basic information about the document, including the document number, the functional group or document owner, the document type, the current revision number, the current document status (e.g., in revision, recently revised, needs to be revised), information regarding pending changes, outstanding document change notices, and any other information necessary for control and tracking. As discussed below, the document database also supports the document retrieval function with associated information such as retention times, storage location, retrievability guidelines, and key words. The document database should be controlled in accordance with policy established by the program management element.

2.3.2.4 Retrieval of Documents

Fundamentally, the document retrieval function ensures that documents are retrieved in a timely manner upon request, and that when a copy of a document is issued, it is the most recent version. The status of the controlled documents should be available to the affected organizations. Additionally, the retrieval function ensures that information regarding pending changes, including references to detailed information, is supplied to anyone requesting the latest copy of the document. For example, if a drawing is requested, the document control organization should also provide the requester with a list or copies of existing change information (e.g., outstanding document change notices, pending changes, and related physical changes in progress). This will alert the requester to upcoming changes that could affect the retrieved document.

The document database needs to provide the capability to support identification of relevant documents. Numerous document identification systems possessing unique advantages and disadvantages regarding time and resources are available. Document identification systems range from the simple, manual control of hard copies to elaborate computer-based, keyword-searchable, full-text databases linked to the document images. Variables that affect the type and degree of sophistication are the size of the facility, the volume of documents included in the CM program, available resources, existing programs, and the retrieval requirements of the users of these documents.

As defined in the program criteria, the document database should have the capability to identify documents within the CM program on the basis of their relationship to particular SSCs (such as a particular pump), types of SSCs (such as motor-operated valves), technical topics (such as fire protection), and other relational data (such as the specific vendor) necessary for the adequate identification of documents. This information should be integrated with the types of information discussed above (e.g., information regarding pending changes) for document control and tracking. Consideration should be given to assigning key words or using fully searchable text files for the most important documents.

Availability and retrieval times should be based on the needs of document owners and users. If the documents are necessary for the day-to-day operation of the facility, they should be available on a real-time or short-turnaround basis (e.g., controlled copies of procedures and P&IDs should be located in a central area such as the control room). Conversely, if the documents are not routinely needed and, if time permits, a retrieval time of 24 hours or more may be acceptable; this is typical, for example, of design basis information used by the design engineering organization for physical change preparation. Many documents included in the CM program fall into the latter category; immediate access is not needed. The selection of appropriate retrieval times calls for formally soliciting and considering input from the document owners and the ultimate users of the documents. This should be followed by periodic monitoring to ensure that document retrieval requirements continue to be adequate. Many facilities employ satellite document distribution centers to encourage the use of controlled copies and to facilitate timely retrieval from diverse work locations.

In addition to DOE 5700.6C, ANSI/ASME NQA-1, *Quality Assurance Program Requirements for Nuclear Facilities,* NQA-1 Supplement 6S-1, *Supplementary Requirements for Document Control, and* Supplement 17S-1, *Supplementary Requirements for Quality Assurance Records,* also provide useful guidance on document control.

2.3.3 SPECIFIC APPLICATION OF GRADED APPROACH: DOCUMENT CONTROL ELEMENT

The document control element is a process, and as such, the graded approach should not be used to eliminate any steps or functions. The identification of types and specific documents to be controlled by the CM program is a function that can be adjusted based on SSC grade. For any facility SSC, there is a fairly standard list of types of documents that could be included in the CM program: lists of materials, flow diagrams, electrical diagrams, isometric drawings, instrumentation logic and schematic diagrams, and calculations and analysis. In many cases, especially for the less important SSCs, many of these types of documents are not applicable or have never existed. Therefore, the inputs limit the scope.

Additionally, for each SSC, a conscious decision should be made regarding how much documentation needs to be controlled to maintain configuration. For the most important SSCs, such as those with safety design requirements, it might be appropriate to control every document type and specific document that is available or can be retrieved. For low-importance SSCs, it might be appropriate to control only basic documents, such as the design requirements, flow diagrams, and test requirements. Documents that are not selected for inclusion within the special controls of the CM program would remain available in the normal document control system.

Furthermore, management options may limit the degree of rigor and detail in the performance of the CM document control functions based on document importance, which in turn is based on the importance of the associated SSC and the priorities assigned by the document owners.

2.4 CHANGE CONTROL ELEMENT

The development of the change control element is discussed below in two stages: the initial development activities and the fully developed program element. The initial development activities include those actions necessary to identify and evaluate existing change mechanisms. The fully developed program element entails the activities involved in ongoing, steady-state change control.

2.4.1 INITIAL DEVELOPMENT ACTIVITIES

Major change mechanisms and immediate actions to improve change control will have been identified by the initial program assessments and described in the CM program plan. This serves as the starting point for a complete review of existing change mechanisms or processes. During this evaluation, corrective actions should be Initiated promptly where necessary to prevent unauthorized, unreviewed, improperly controlled, and poorly documented changes. An overview of the initial development activities is presented as Figure 2–13, and these activities are discussed in more detail below.

2.4.1.1 Change Process Identification

A survey should be conducted to identify each change source (such as operations, maintenance, procurement, procedures, and software) for each major change type (physical changes, document changes, or design changes resulting in either). Facilities should focus on each change type (physical, document, or design) individually to determine which sources initiate these changes and which mechanisms are used to identify, evaluate, and control these changes. Input from each facility organization should be solicited to identify the change sources and the control processes currently in use. All change sources, mechanisms, organizations, and control processes that can possibly affect configuration management should be identified. The identification of change processes is often the most critical step to achieve effective change control. Change mechanisms that are not identified cannot be controlled.

Facility personnel should strive to identify subtle change sources that do not conveniently fall in one of the previously identified sources. Some change mechanisms exist independent of formal procedures or processes. For example, if the system engineer approves minor changes such as different gaskets, this should be identified and reviewed as a change source. Mechanisms for temporary physical changes and temporary document changes should be identified for formal change control.

2.4.1.2 Change Process Evaluation

After the various sources of change have been identified, a determination should be made regarding which of those processes after the configuration and therefore need formal controls. Formal control measures should be provided for any change process that affects either (1) the physical configuration, as defined by the SSCs included in the CM program or (2) the facility documents included in the CM program. An example of a change mechanism that might be out of scope is the control of scaffolding that cannot affect an SSC within the CM program (i.e., no system interaction through failing, etc.) or its associated documentation.

The adequacy of the existing controls should be evaluated against each of the basic change control functions, depicted in Figure 2–14 and described in Section 2.4.2. Checklists may be used to ensure that the evaluations are complete and documented. Any weaknesses or deficiencies should be identified. For example, if operations or maintenance personnel make undocumented changes to the facility, existing controls are not adequate and do not meet the objectives of the CM program. Similarly, if operations or maintenance personnel make changes without considering and documenting whether

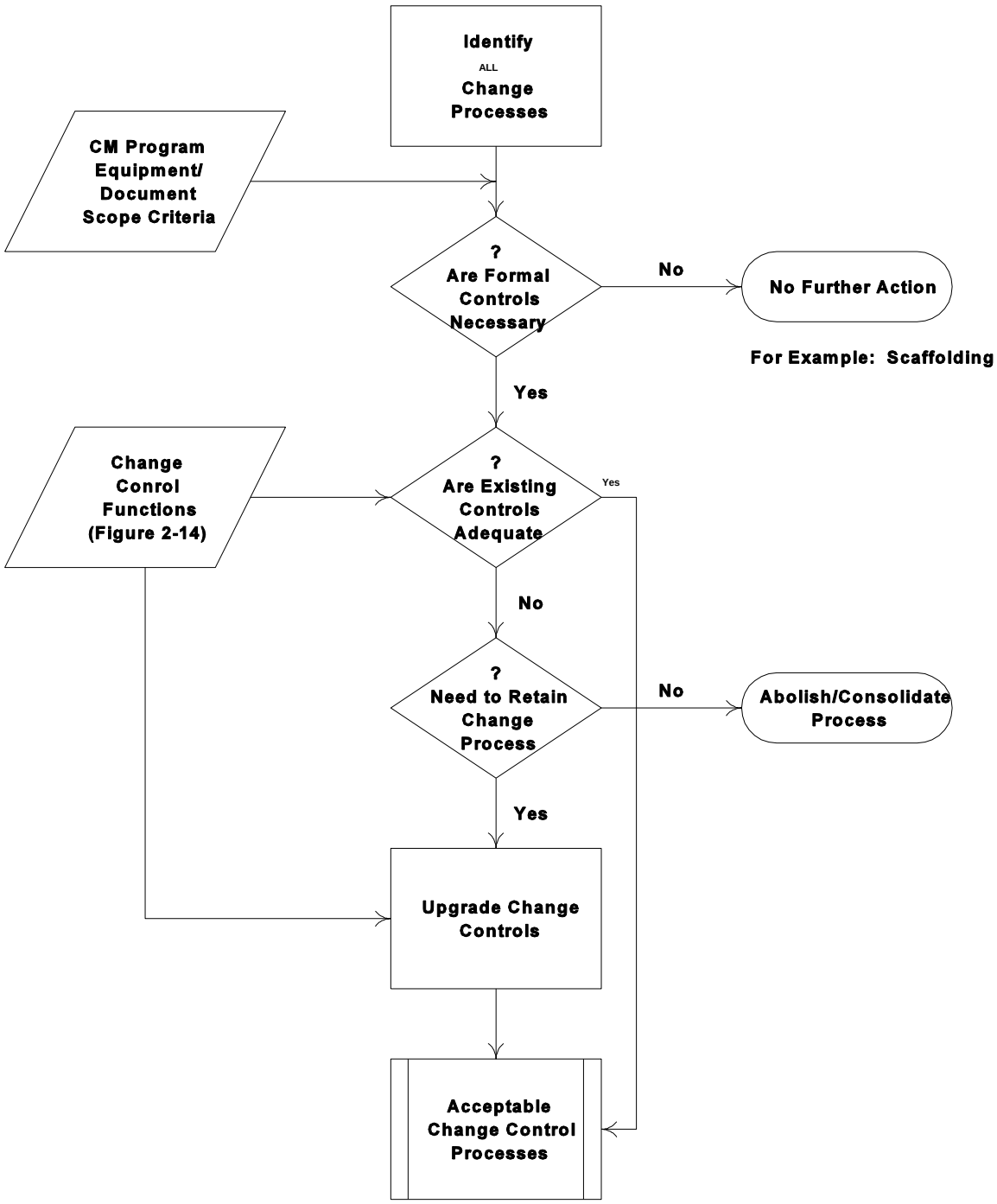

Figure 2-13. Change Control Element: Top-Level Development Flowchart

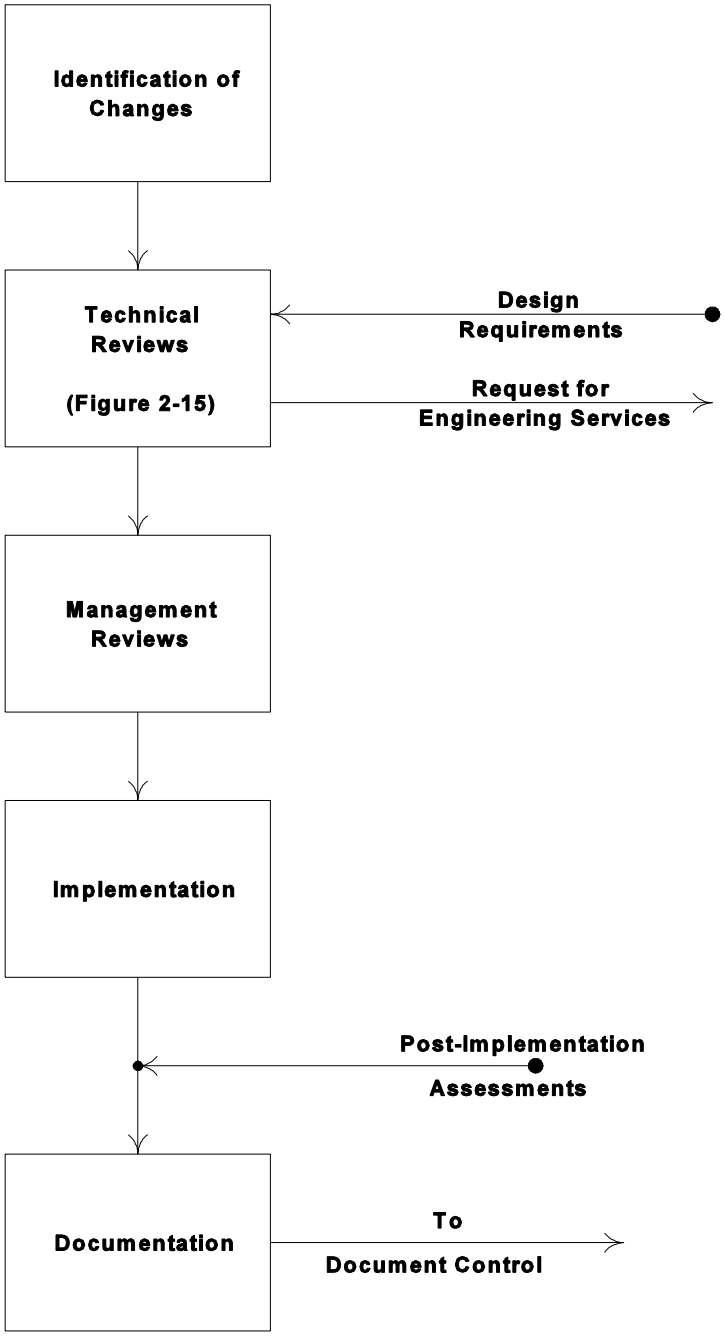

Figure 2-14. Change Control Element: Change Control Functions

these changes are supported by the design requirements, the associated change mechanisms need attention. Corrective actions should be initiated promptly where necessary to prevent unauthorized, unreviewed, improperly controlled, or poorly documented changes.

The conditions that initiate the change mechanism and the organizations that use the change mechanism should also be documented. This information will support the evaluation of potential consolidation of existing change mechanisms. It will also be useful as a starting point for a listing of change mechanisms that should be Included in the governing change control procedure.

2.4.1.3 Change Process Elimination, Consolidation, and Upgrade

For each change mechanism, a determination should be made as to whether it will be retained, improved, or terminated. When deciding which change mechanisms to retain, consideration should be given to (1) the extent and impact of improvement actions necessary to eliminate deficiencies and weaknesses and (2) potential consolidation with other similar change processes. The ability to effectively manage many change processes should be considered. Consolidation of a deficient change process with a similar, acceptable change process is often preferred to upgrading the deficient process.

A typical facility may have a number of different organizations making changes to the facility using many different control mechanisms. As a result, unnecessary management and control problems can arise. To minimize these problems, consideration should be given to consolidating as many types of changes as practical into a few well managed control processes for use by all facility personnel. For example, various temporary physical change mechanisms, regardless of which organization (e.g., Engineering, Operations, Maintenance) is making the change, can be consolidated into a single process.

For each change mechanism retained, upgrade actions should be defined to bring the process into alignment with accepted methods and requirements established by the change control program element. For example, the temporary change control process might be upgraded to include the following needed features: technical reviews of proposed temporary changes prior to implementation; preparation and distribution of interim, marked-up drawings and procedures for use by operators and other facility personnel; and periodic assessment (e.g., at least every 6 months) of the continued need of the temporary change until removal.

Change processes should be streamlined and efficient to ensure that they are used. Also, they should be enhanced to accommodate change faster and easier. Change processing should be defined by procedure for each approved change mechanism. Streamlining of internal program forms and documents is important to improve comprehensibility and ease-of-use. This applies throughout the CM program, but is particularly applicable to change control, which directly interfaces with the most organizations and personnel. Effective internal forms and documentation associated with change control have the following attributes: they facilitate complete and timely change identification and control, they are user-friendly and encourage participants to use them, and they provide for management tracking and reporting.

Upgrade and consolidation of change mechanisms typically include revised procedures, revised forms, and associated training. Active involvement of the process owners in answering questions and providing clarifications can be critical to a smooth transition to new or different processes. An effectiveness review of the upgraded or consolidated processes after 6 to 12 months can be very useful in defining further improvements and efficiencies.

The initial development of the change control element is complete after the change control processes have been identified, reviewed, consolidated, upgraded, and determined to be acceptable.

2.4.2 FULLY DEVELOPED ELEMENT

Under fully developed change control, changes may only be identified, reviewed, approved, implemented, and documented through change processes that have been determined to be adequate. The following discussion presents recommended features of, and methods for, accomplishing each of the basic change control functions, presented in Figure 2–14.

2.4.2.1 Identification of Specific Changes

Specific changes should be identified only within established change processes. The need for a potential change may be identified by anyone within the facility and should be documented by the requester to support the processing of the change request. As defined by the CM program criteria, each proposed change should be described adequately to support technical and management reviews prior to approval. Change initiation should include the name of the requester, a description of the proposed change, the affected SSCs and associated SSC grade, the reason for the change, alternative solutions, due date, and constraints. It should also include any other information needed for review, tracking, approval and further processing.

2.4.2.2 Technical Review of Changes

Effective change control involves formal, multidisciplined, technical reviews for each change. Some of these are necessary to maintain configuration and others are defined as good management practices. The technical reviews defined by the CM program criteria to maintain configuration can be grouped into these areas: design envelope review; identification of affected hardware and documents; identification of post-implementation acceptance criteria; and, safety, environment, and mission reviews.

Design Envelope Review. Design envelopes are pre-approved limits or constraints within which changes may be made within the bounds of the design requirements. For example, suppose the design authority has approved three different lubricants as acceptable for a given valve and specifies that they may not be mixed. If the maintenance organization desires to switch from one approved lubricant to another, the change needs to be recorded and documented; however it is not a design change. As another example, suppose the design authority has specified a pump actuation setpoint as 55-65 psig and the operating organization has requested the actual setpoint of 62.5 psig to be reduced to 57.5 psig to reduce spurious actuations. Again, the change is a physical configuration change, which needs to be documented, but it is not a design change. As a third example, if the design authority has determined, by evaluation, that the maximum number of plugged tubes for a specific heat exchanger cannot exceed 15 percent, this value becomes the design envelope for future maintenance work. Up to this limit, the maintenance organization does not have to check with the design authority each time it needs to plug tubes because the number is within the design envelope. However, if the maintenance organization needs to exceed this limit, evaluation and approval by the design authority needs to be obtained, and a new design envelope may be established. The same approach may also be used for setpoint changes, torque values, machining tolerances, vibration limits, or other routine activities where design envelopes can be established.

Changes that are shown to be within existing design requirements or defined design envelopes do not need evaluation by the design authority. Any personnel or organization, such as operations, maintenance, technical support (i.e., system engineers), or others, may perform the design envelope review, provided they are competent to make such an evaluation and have access to the appropriate design requirements, or specific design envelopes. The CM equipment database provides access to design requirements and design envelopes. Figure 2–15 shows the general approach for performing design envelope reviews, described further below.

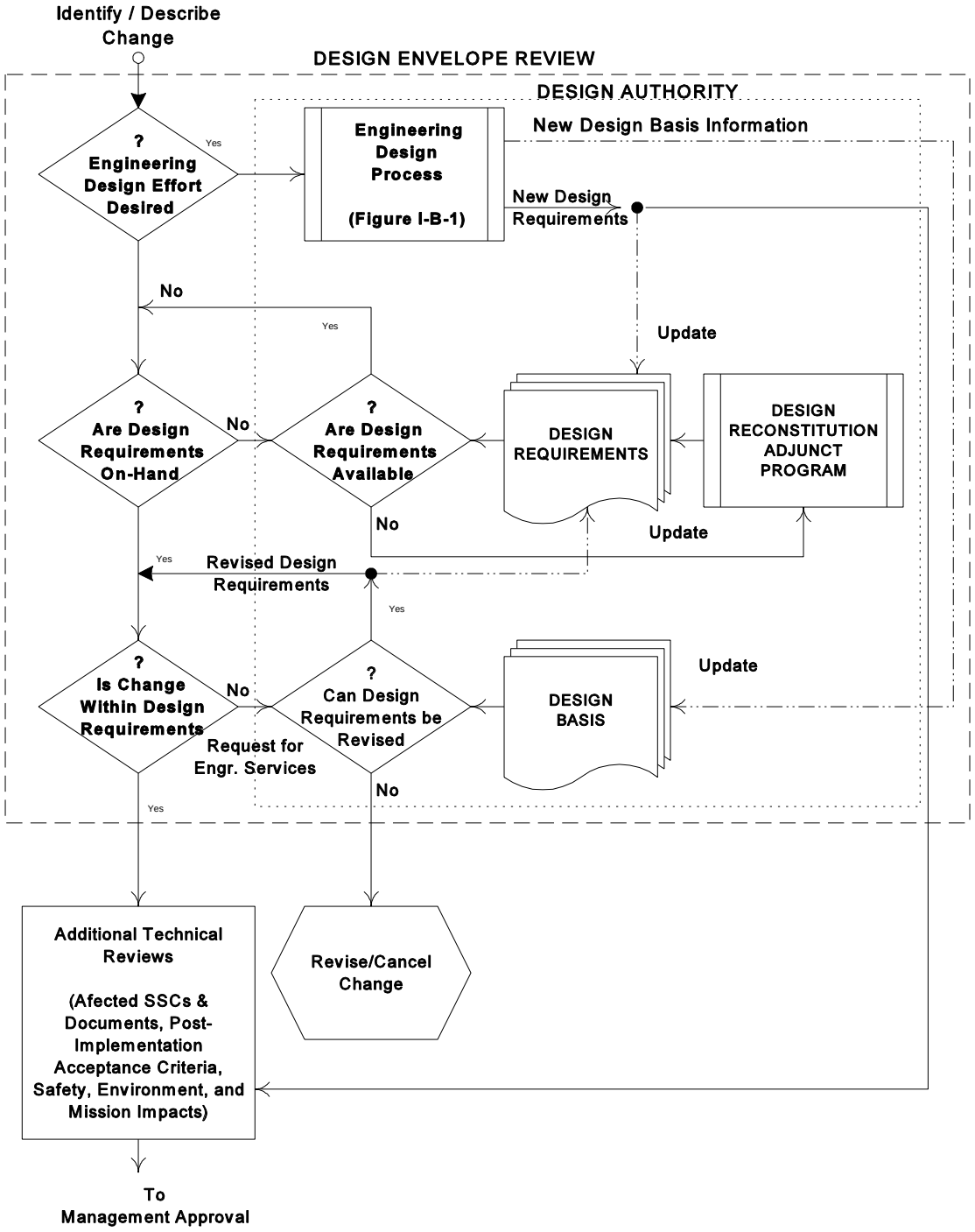

Figure 2-15. Change Control Element: Design Envelope Review Process

First, a determination should be made regarding the desirability of design engineering support. Design support may be desired for many reasons. If the organization performing the design envelope review determines that design engineering support is desired for the design envelope review (e.g., based on known changes to the design requirements or technical complexity), a request for design engineering assistance should be made. Requests for design assistance may be made through the systems engineer, the facility technical support organization (or other interfacing entity) or directly to the design authority.

If the reviewing organization does not desire design support, the reviewer should determine if the necessary design requirements or design envelopes are available for the review to proceed. If not, assistance from the design authority is needed and should be requested. If requested, the design authority could search the applicable information sources (such as the CM equipment database, calculations of record, and design basis information) and provide this information to the requesting organization to allow them to proceed with the design envelope review. If the design requirements are not available, the design authority may need to develop new information, which will be included in the CM equipment database. The design authority may also define design envelopes for future use.

If the design requirements are available, the proposed change should be compared to the design requirements to determine if it is within the existing design envelope. The proposed change is ready for additional technical reviews upon determination and documentation that the change is within the bounds of the applicable design requirements. Organizations outside the design authority should be conservative in their review of design requirements. The design engineering organization should be consulted when there is any doubt as to whether the proposed change is within the design envelope.

If the proposed change is not within the design envelope, it involves a design change and design engineering assistance is necessary to proceed. In some cases, the revised design requirement is within the current design basis and, therefore, could be approved with relative ease. If the proposed change is beyond the current design basis, the development of a new or revised design basis is necessary to support the change. The new or revised design basis generally involves significant efforts by the design authority and potentially includes external evaluations and approvals. In such a case, the facility management would weigh the development time and investment against the benefits of the proposed change. An adjusted, more cost-effective change might be possible that could accomplish the objectives of the original change within the current design basis. Administrative review and approval to develop the proposed design change should be obtained. The design authority can recommend three general courses of action: (1) change the design requirements after reviewing applicable design basis information; (2) suggest that the change request be canceled; or (3) suggest that the proposed change be revised, if possible, to stay within the limits of the existing design requirements. The requesting organization should select the option. For physical changes that are to be implemented, the design authority should prepare a design change package consistent with the design process and controls. The design change package may accomplish the additional technical reviews and should facilitate outstanding technical reviews, management review, and implementation (i.e., with no further action by the requesting organization).

Identification of Affected Hardware and Documents. Once it is determined that a change can be made within the defined design envelope or within new or revised design requirements, each affected SSC or document within the CM program needs to be identified. This includes the documents that are directly affected by the change, such as drawings. It also includes those that are indirectly affected by the change, such as the SAR or a procedure containing a system drawing that will no longer be accurate. By complete and thorough review, each affected item may be identified, thereby maintaining the basic CM relationships during implementation of the change process. Examples of affected items that are sometimes overlooked are design basis information, safety analysis reports, CM databases, operating and maintenance procedures, and training lesson plans. The CM equipment database and the

document database should be used as primary tools to identify affected documents. Cross-disciplinary and cross-organizational review may also be necessary if the databases do not provide adequate information to complete this review.

Identification of Post-Implementation Acceptance Criteria. Methods and acceptance criteria should be defined for post-implementation testing (e.g., post-modification testing for physical changes) prior to change implementation. Post-modification testing ensures that the SSC performs as intended and operates within the design requirements after the change is installed and before turnover to operations. These tests serve as a final and independent adequacy check of the design and technical reviews for the proposed change.

Safety, Environment, and Mission Reviews. Each change needs to be reviewed to ensure that the safety, environment, and mission objectives are preserved.

Other Reviews. The following examples illustrate other reviews likely to be associated with change development and approval, but not necessary to maintain configuration. Reviews performed as a matter of good practice might include a review to determine the costs and benefits associated with a change in order to facilitate management reviews and decision making. Facility walkdowns may be necessary because there is a lack of confidence that the physical configuration is accurately reflected in the as-built drawings. As another example, once the change is fully defined, the impact on the operations schedule for implementation would generally be reviewed. Some technical reviews of changes are imposed by external requirements. For example, DOE 5480.21, *Unreviewed Safety Questions*, requires review of each proposed change to determine whether prior DOE approval is required. In addition, DOE may have established additional reviews and review criteria consistent with its management and oversight of the DOE-owned facilities. Additional reviews for determining quality assurance actions may also be necessary.

Some DOE facilities use Change Control Boards (CCBs) for all or part of the technical evaluation of changes. For CCBs to be effective, they need to perform the technical review functions discussed above or ensure that they are performed for each change.

2.4.2.3 Management Review of Changes

As defined by the CM program criteria, management should review the proposed change to verify that the technical reviews have been performed adequately, the change package is complete and ready for implementation, any necessary external approvals have been obtained, and that the change is authorized for implementation.

Management reviews may also consider whether the need for the change exists, whether the benefits of the change warrant the cost and schedule impacts, whether adequate resources are available for implementation, or whether management approval should be based on other criteria. Some aspects of these management reviews may take place prior to finalization of the change package; others, subsequently. For example, management review and approval of proposed major design changes would be expected prior to significant expenditure of resources.

Management review and approval requirements may vary based on the magnitude, cost, or the importance of the change (grade of SSCs involved). For instance, changes related to safety SSCs might call for senior management approval, while changes related to low importance SSCs might call for only the approval of first-line management.

The management review process should be streamlined to the extent practicable. Management reviews by many different levels and organizations can dilute accountability for a substantive review and increase the review cycle duration without adding value.

2.4.2.4 Implementation of Changes

The change package should be reviewed prior to actual implementation of physical changes to ensure that it is complete and constructible, that there are no unidentifiable physical interferences, and that the change is likely to meet defined post-implementation acceptance criteria. This constructability review should be performed independent of the original design organization. A modification or construction package may be used to define implementation instructions.

Any deviations from the defined change package during implementation/construction should be identified, reviewed, and approved by the design authority. Provisions for this process, often called field change requests, should be defined by procedures. Following engineering evaluation and approval, field change notices should be issued.

As-built documentation should be prepared at the completion of implementation of physical changes.

Post-modification testing should be performed in accordance with methods and acceptance criteria defined during the change development. If an SSC fails to meet the post-modification acceptance criteria, it should not be turned over for normal operations until either a technical review and any necessary follow-up actions have been completed, or the SSC is returned to its original condition and tested satisfactorily.

Special attention should be given to the partial implementation of changes. Two types of partial implementation can occur: (1) staged implementation, where availability of time, money, or equipment dictates that the modification has to be planned and implemented in a staged manner or (2) interrupted implementation, where the implementation could not be completed as planned for any of a variety of reasons. Failure to identify this condition and take the proper precautions can lead to the premature closure of the modification package resulting in an unanalyzed condition, as well as facility documentation that does not reflect the as-built configuration. Partially implemented changes should be reviewed and approved by the design authority prior to operation. This design engineering review should ensure that the original technical reviews are still valid or that new technical reviews are performed, as necessary.

2.4.2.5 Documentation of Changes

Change documentation is produced at each step of the change process (i.e., identification, review, approval, and implementation). This is necessary to indicate what is accomplished, to ensure that the details of the proposed change are established and understood, and to record as-built information. The change documentation function is established as a unique and separate function within the change control element to emphasize that change closeout ensures that the change documentation is complete and all affected documents are identified and updated.

Because essentially every change directly or indirectly affects associated documentation, a major interface exists between the change control and document control elements. Directly affected facility documents, such as drawings, are confirmed to be as-built following implementation. Indirectly affected documents are identified as part of the technical review of changes. The affected documents should be updated in a timely manner. Critical facility documents, such as drawings and procedures needed for operation, should be updated prior to placing the SSC in operation.

Change packages should be used to capture the change request, the various technical reviews and evaluations, the management review, and the implementation results. Related information (such as the change request, design package, installation package and, post-modification testing) should be combined into a single file or change package. This information should be kept in one location until installation is complete. Furthermore, consideration should be given to assigning an individual the responsibility for tracking physical change status and ensuring that the change package is complete at all times up to and including turnover to the document control organization after installation. Many facilities have successfully used system engineers to perform this function.

2.4.3 SPECIFIC APPLICATION OF GRADED APPROACH: CHANGE CONTROL ELEMENT

Like document control, change control is a process. Once a design requirement is established for an included SSC or a change is proposed, that information should be controlled by the change control element. The level of effort is influenced primarily by the number of specific SSCs included in the CM program and the number of changes that are proposed. However, management may exercise options to limit the degree or rigor and detail when reviewing and approving changes based upon the importance of the SSCs involved. For example, adjusting the degree of technical reviews and management sign-offs to be commensurate with the SSC grade is appropriate.

2.5 ASSESSMENTS ELEMENT

The assessments element may be considered fully developed on completion of the following

- Initial CM programmatic and physical configuration assessments
- Detailed action plans and procedures for conducting post-implementation assessments
- Ongoing assessment programs established by procedure and effectively implemented

Senior management should retain overall responsibility for management assessments (i.e., all initial and post-implementation assessments and the periodic program effectiveness assessments). Direct participation of senior management during these assessments is essential. This process should also involve other levels of management, as appropriate. Management assessment results should be documented. Senior management should take prompt action and document resulting decisions in response to recommendations resulting from the management assessment process. Follow-up should include an evaluation of the effectiveness of management's actions.

2.5.1 INITIAL ASSESSMENTS

2.5.1.1 Vertical Slice Assessments

The following is a description of the vertical slice assessment process. An overview of that process is presented as Figure 2–16.

Identify the systems to be assessed. System selection is determined using judgment and anticipated need to obtain a representative cross-section of existing SSCs, control programs, and document types. For large, complex facilities, two or more vertical slice assessments are usually needed to detect patterns and major existing problems the larger the number, the more accurate the results. As defined by the CM program criteria, at least two representative vertical slice assessments should be performed, with one on a safety system related to the principal facility hazard.

Collect and compare system-related information. A comparison is made between the available design basis information and design requirements to determine consistency and technical adequacy. Special

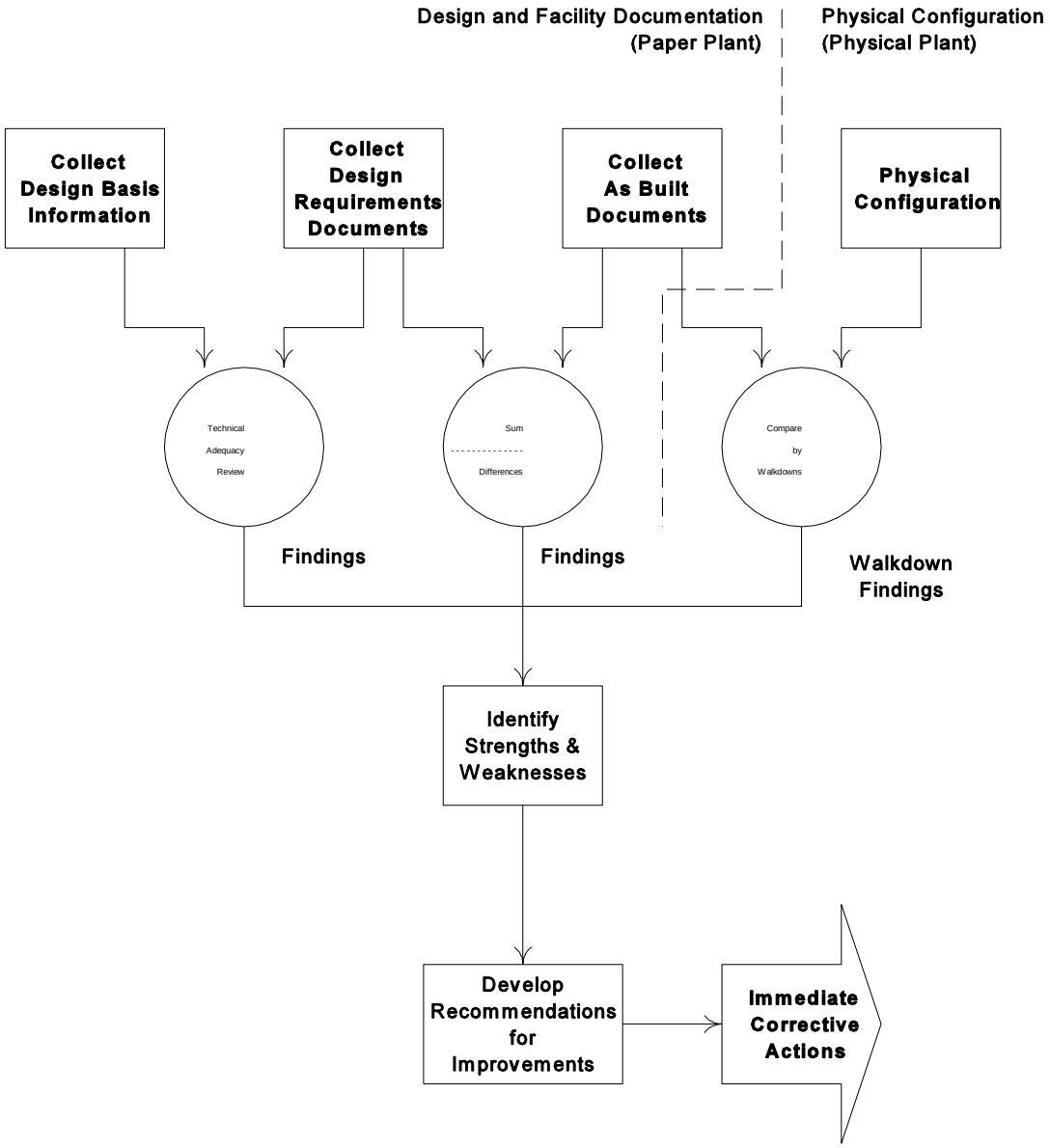

Figure 2-16. Assessments Element: Vertical Slide Methodology

attention should be given to consistency between the assumptions made in different design basis calculations; the design basis documentation and design requirements documentation; and, the design requirements against one another and as reflected in the SAR, procedures, vendor material, and other sources of design requirement information. Another comparison should made between documents containing the design requirements and the as-built documents (such as drawings and procedures). Inconsistencies, technical inadequacies, and missing information should become preliminary assessment findings to be analyzed further.

Perform walkdowns and compare the existing physical configuration to the facility documentation. Walkdowns are an integral part of a vertical slice assessment. They are performed to establish the as-found facility physical configuration, the results of which are compared to the associated documentation in order to identify discrepancies. Initial walkdowns provide insight Into the accuracy of existing facility drawings. Walkdown methods and follow-up actions are addressed in the discussion of physical configuration assessments In Section 2.5.3.2.

Evaluate preliminary assessment findings to identify programmatic strengths and weaknesses. Correcting each specific finding without determining the programmatic deficiencies that allowed these findings to occur is not the objective. Final analysis of the findings should result in the determination of the extent of weaknesses and the underlying causes. For example, a discrepancy between the existing configuration and the as-built documentation might be due to inadequate interfaces between the change control and document control programs, while differences between the design basis information and design requirements might be due to inadequacies in the design engineering process. Once programmatic strengths and weaknesses are identified, this information should be factored into the associated CM program plans to assist in CM program development.

Develop corrective actions. As a result of the initial assessments, corrective actions should be developed to address the identified weaknesses. Recommendations should be made addressing programmatic deficiencies that, if corrected, will prevent these types of problems from occurring in the future. The CM program management will evaluate the initial assessments, including recommended corrective actions, and determine the appropriate actions for the facility. Program management should take immediate corrective actions to remedy the major programmatic weaknesses. Further, specific interim upgrades may be prudent in areas such as change control, document control, design control, and physical configuration determination.

2.5.1.2 Horizontal Slice Assessments

The horizontal slice assessment process is described in the following sections. An overview of that process is presented as Figure 2–17.

Identify the programs or topics to be assessed. Likely candidates for horizontal assessments are the change control program, the document control program, the design change process, a topical program common to many SSCs, the design requirement documentation and design reconstitution efforts (if underway at the time). As defined by the CM program criteria, at least two initial horizontal assessments should be performed. One is to be conducted on the change control program and another in a topical area such as seismic, fire protection, or environmental qualification.

Develop evaluation criteria that define the requirements for the program. These evaluation criteria are similar to the performance objectives and criteria used by DOE and the commercial nuclear power industry for conducting performance-based assessments. Examples of upper-tier evaluation criteria in various areas of the CM program are as follows:

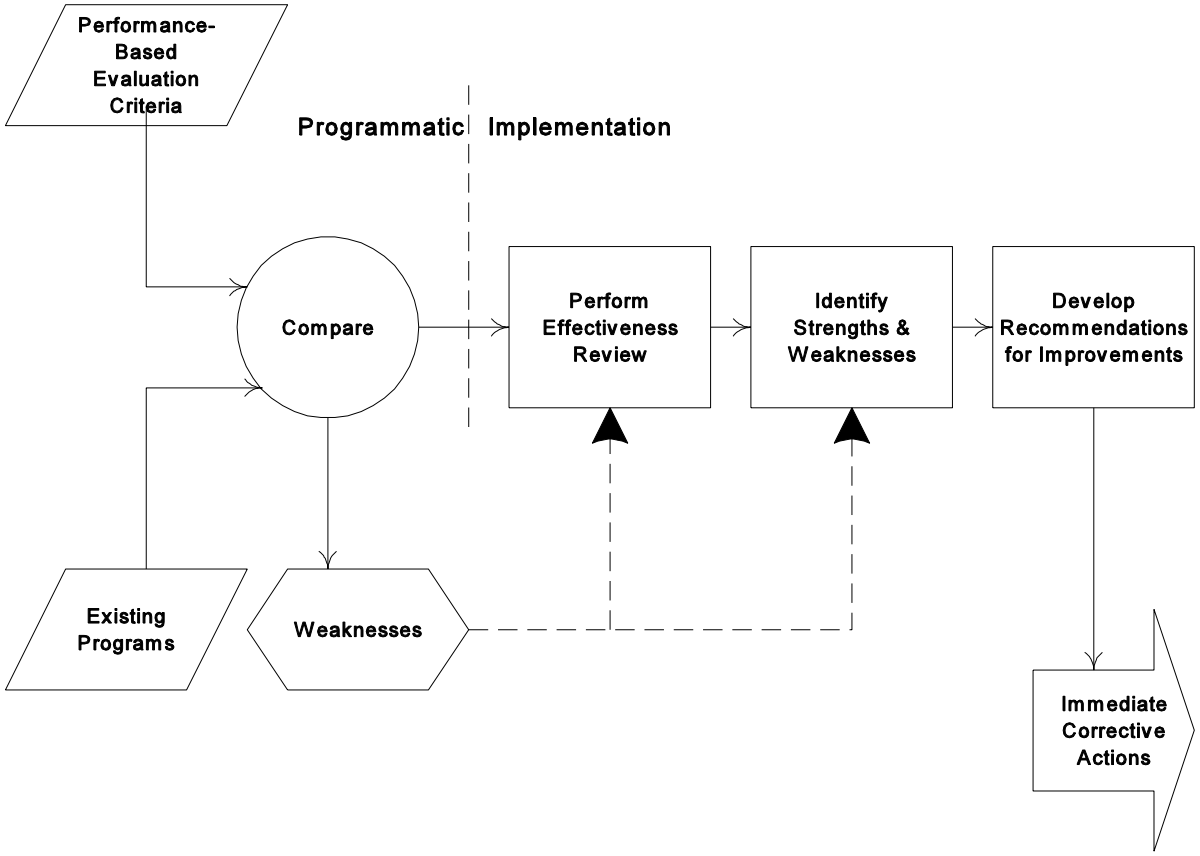

Figure 2-17. Assessments Element: Horizontal Slice Methodology

- A formal CM program is in place and governed by published directives, a CM program plan, and CM implementing procedures.
- Organizational and programmatic interfaces, including responsibilities and authorities, are clearly defined and understood by key personnel responsible for implementing CM program functions.
- The design requirements for SSCs included in the CM program are identified, documented, retrievable, and maintained current for use by facility personnel.
- Change mechanisms are identified and controlled.
- Proposed changes to facility hardware and documents are technically reviewed to ensure consistency with the design requirements.
- Changes are documented and affected documents are updated.
- Documents within the CM program are consistent with the design requirements and the physical configuration.

Compare existing program implementation with the evaluation criteria to determine strengths and potential weaknesses. Determine whether the existing program is comprehensive and identifies obvious omissions.

Figure 2–18 shows the recommended method for evaluating existing procedures. Starting at the top left corner, the facility CM program criteria are identified by applying the graded approach to the general CM program criteria. The existing programs and procedures providing configuration management functions are then identified and analyzed. The program objectives, methods, and procedures are considered. Functional flowcharts are developed for the existing procedures. This evaluation of existing procedures can provide a basis for determining whether they are programmatically adequate for accomplishing the CM program criteria.

Based on functional flowcharts, judgments can be made regarding the strengths and weaknesses of the processes prescribed by the procedures. An assessment can be made of how well the procedures achieve their objectives and whether the procedural links and other interface considerations are adequate. Using the functional flowcharts, an assessment also can be made regarding how well the functions actually provided by the existing procedures match the functional criteria of the facility CM program. The comparison of the functional capabilities of the existing programs may show that no additional work is necessary to accomplish the CM program functions, or it will indicate where improvements are needed. The functional flowcharts for existing procedures may indicate strengths and weaknesses not related to the CM program; other improvements may be appropriate. Assessment of procedures without the aid of functional flowcharts can result in misleading conclusions. The time and effort involved in developing functional flowcharts is well invested.

Perform an effectiveness review in the field. This review is an assessment of how well the program is implemented. During this step, information is gathered through interviews with knowledgeable facility personnel, additional document reviews, and observation of work in progress to determine the program's effectiveness at accomplishing the objectives. Therefore, emphasis during the effectiveness review should be placed on problems. This performance-based approach is essential to identifying the underlying causes of these problems and effectively upgrading a weak or poorly implemented program. This is not a compliance review.

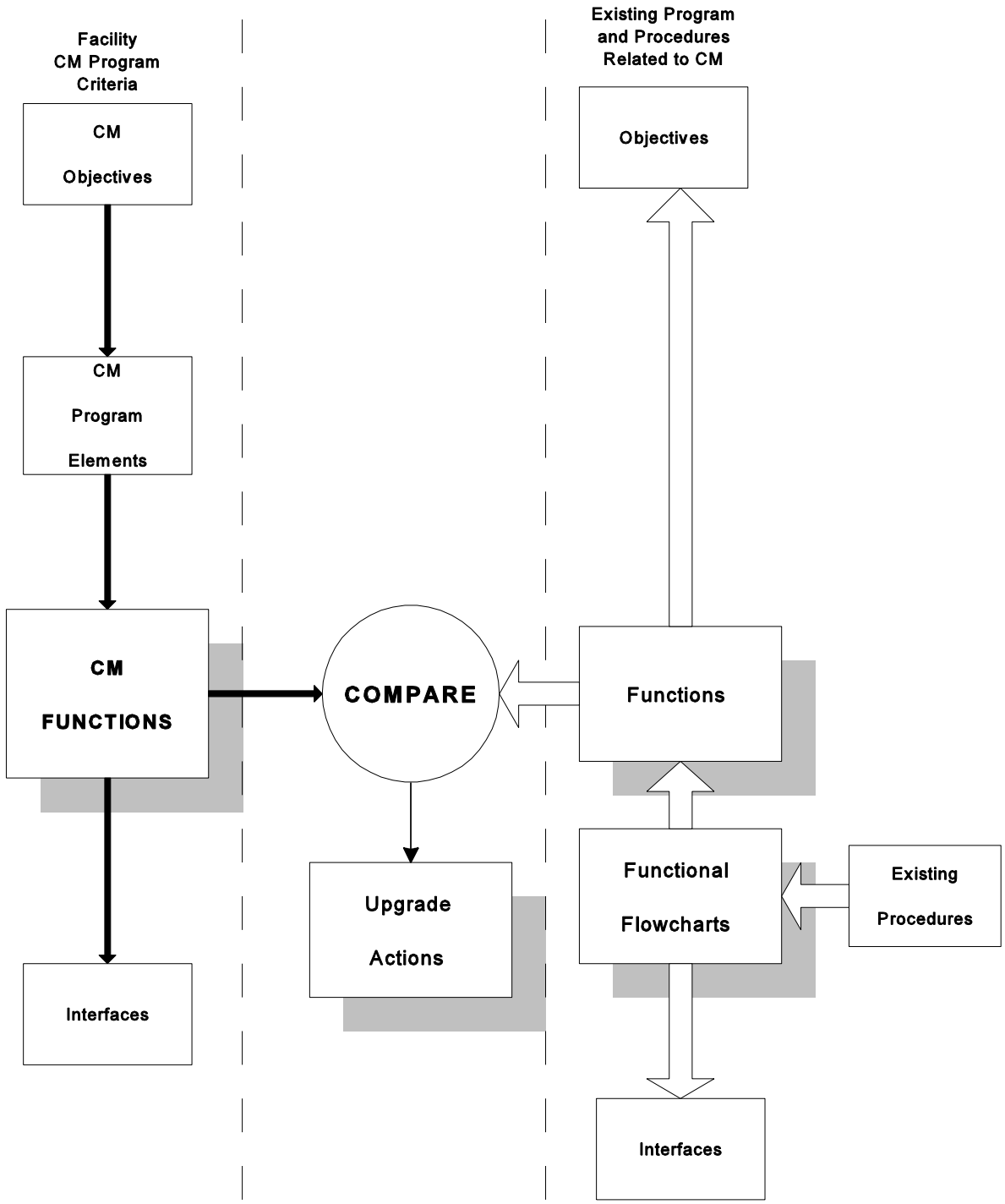

Figure 2-18. Comparative Procedures Review

Identify relevant programmatic strengths and weaknesses and make recommendations for improvements. Compare the potential weaknesses identified during the document review step with the problems identified during the effectiveness review step. Recommendations should be made to correct programmatic weaknesses and prevent these types of problems from occurring in the future. Strengths should be identified and acknowledged to ensure that resources are properly allocated for sustaining program strengths. This information should be factored into the associated CM program plans to assist in CM program development. The CM program management will evaluate the initial assessments, including recommended corrective actions, and determine the appropriate actions.

2.5.2 POST-IMPLEMENTATION ASSESSMENTS

Post-implementation assessments to determine the adequacy and effectiveness of a program are conducted shortly after program implementation and prior to final turnover to facility personnel for ongoing use. These assessments are not compliance audits. Like initial assessments, these post-implementation assessments employ vertical and horizontal slice methods. Post-implementation assessments include CM program effectiveness assessments, DIS field validations, and MCA program effectiveness assessments.

2.5.2.1 CM Program Effectiveness Assessment

Horizontal slice assessments should be performed shortly after each element of the CM program is implemented (i.e., within 12 months of program element implementation). The main objective of the CM program effectiveness assessments is to examine newly implemented CM programs and processes (such as change control, the design requirements process, and document control) to identify and correct weaknesses prior to authorization for use. These post-implementation CM program assessments also serve as a model for ongoing, periodic program effectiveness assessments.

The horizontal slice assessment techniques used for the post-implementation CM program effectiveness assessments are identical to those employed in the initial horizontal slice assessments. The recommendations for improvement resulting from the initial assessments should be used as a starting point for the CM program effectiveness assessments. This will ensure that the previously identified problems have been adequately addressed and resolved. The post-implementation program effectiveness assessments should go beyond the initial assessment findings to ensure that the newly developed and upgraded programs are effective. Assessment findings and corrective actions should be documented.

2.5.2.2 Design Information Summaries Field Validations

As each DIS is issued by the design reconstitution adjunct program, a field validation should be provided to ensure that the design requirements are accurately reflected in both the physical configuration and the associated facility documents. Each DIS may receive varying degrees of technical validation, ranging from a review of specific critical design basis information to detailed vertical slice assessments of the entire system. Within each DIS, the system engineer or other technically qualified person should check the critical design requirements information for consistence, with the hardware and documents on a case-by-case basis.

Full vertical slice assessments should be performed on a sample basis to provide a broader assessment of the design reconstitution process. The sample should be large enough to, provide assurance that design basis information and design requirements established by design reconstitution are accurately reflected in the physical configuration and associated documentation. A representative sample of at least 5 percent per facility would be prudent. In selecting the sample systems for these detailed DIS validations, the following criteria should be considered: status of original design and

construction documents, system importance to safety and mission, change history, and number of outstanding open items identified during design reconstitution. Systems that support accident prevention and mitigation and design documents for which the accuracy of the original calculations and analysis were suspect, receive highest priority. If the representative sample indicates substantive weaknesses, immediate corrective actions and assessment of an expanded sample should be initiated.

2.5.2.3 MCA Adjunct Program Effectiveness Assessment

An MCA adjunct program effectiveness assessment should be performed after the MCA program is fully implemented but prior to final turnover to facility personnel for continued use. The main objective of the MCA adjunct program effectiveness assessment is to provide a technical quality review of the MCA methods used, input assumptions, and final products. This review should be performed by persons other than those who did the work and should provide assurance that the MCA information was property developed and is technically appropriate and accurate for its intended use. Therefore, the MCA adjunct program effectiveness assessment should include, but not be limited to, an accuracy and appropriateness check of the following:

- Final identification of the life-limiting components
- Detailed MCA analysis (evaluation of aging mechanisms and conduct of baseline measurements)
- Final determination of remaining facility lifetime
- Trend analysis and monitoring
- Life extension techniques (development and application)

2.5.3 ONGOING ASSESSMENTS

2.5.3.1 Periodic Program Effectiveness Assessments

These assessments periodically examine existing functions and processes related to the CM program to ensure their continued effectiveness and to identify improvements and enhancements, if needed. Similar to the initial assessments, periodic program effectiveness assessments use a combination of vertical slice and horizontal slice assessment methods. Objective measures and criteria to assess effectiveness should be defined and used. These periodic assessments should be used as the technical basis for adjusting the CM program by increasing or decreasing the controls. Periodic program assessments should be performed at sufficient intervals (such as every 3 years for full vertical slice or horizontal slice assessments) after implementation to provide management with the assurance that these CM control programs are functioning as intended.

2.5.3.2 Physical Configuration Assessments

Physical configuration assessments test whether the physical configuration is accurately reflected in the facility as-built documentation. Physical configuration assessments, or walkdowns, are an integral part of any vertical slice assessment, and therefore, they are included in initial assessments, post-implementation assessments (related to DIS field validation), as well as ongoing assessments.

While the processes of walkdowns, as-builting, and vertical slices have significant overlaps, the distinctions among them need to be understood. One distinction is based on the products of these processes. Walkdowns produce a set of marked-up documents that reflect the actual physical configuration and identify discrepancies with the currently-approved facility documentation. The as--builting process produces as-built documents that have been field-verified and design-verified. Vertical slice products include an evaluation of the extent, significance, and root cause of discrepancies

identified in walkdowns. Vertical slice assessments are primarily diagnostic and would not generally produce discrepancy resolutions or as-built documents.

Walkdowns. During walkdowns, the as-found configuration is identified by comparing the existing physical configuration with the facility documentation to identify any discrepancies, typically by marking up the documents. Appendix 11–C provides detailed guidance for conducting walkdowns. Walkdowns are sometimes conducted to record manufacturers' nameplate data from equipment, to identify missing or incorrect equipment labeling, to determine the present material condition of equipment, and to identify potential physical interactions between equipment (such as non-seismically qualified equipment mounted In such a position as to impact seismically qualified equipment during an earthquake).

Physical configuration assessments may be performed on a sample basis, with the sample providing a representative cross-section of component types within the system being assessed. The sample should be large enough to ensure that a statistically significant portion of the system and its components are chosen. For instance, the sample should Include major and minor components, large and small bore piping, and instruments and controls. Minimum thresholds for determining an acceptable number of discrepancies should be established prior to walkdowns based on proven statistical techniques (e.g., similar to those used in quality programs for the selection of samples and the determination of acceptability).

If the initial physical assessments confirm that the facility documents accurately reflect the physical configuration, further physical configuration assessments should be included on a sample basis with periodic program effectiveness assessments. However, if the initial physical assessments indicate that substantive discrepancies exist (either in number or type) between the physical configuration and its documentation, appropriate immediate corrective actions should be identified to establish agreement between the physical configuration and the facility documentation.

The corrective actions for substantive discrepancies include additional walkdowns to characterize and determine the extent of the problem. Sometimes the discrepancies can be isolated to certain systems, certain modification vintages, or certain change mechanisms (modification processes). If the extent of the problem can be limited, appropriate corrective actions can be directed at the root cause. Where control of the physical configuration has been lost, walkdowns of every important system may be necessary. In this case, a justification for continued operations may be necessary if continued operations are desired.

As-Builting Process. As-builting is a process that involves determining the actual physical configuration that exists at a point in time, identifying any discrepancies with the facility documentation, and technically resolving those discrepancies. In some cases, discrepancies arise simply because the facility documentation is incomplete or inaccurate in some details. In other cases, discrepancies arise because inadequately controlled hardware changes caused the physical configuration to become different from the facility documentation. The level of detail of a particular facility document type establishes the threshold of the corrections that need to be made. If a facility document provides, or is intended to provide, a level of detail that includes information that does not agree with the actual physical configuration, those discrepancies should be identified and resolved. Leaving incorrect or unverified information on a document is likely to mislead users of the document. Further, any information that is left on as-found documents and has not been verified should be clearly identified.

The resolution of the as-found discrepancies needs a technical review to determine if the physical configuration is correct (in accordance with the currently-approved design requirements) or if the facility documentation is correct (the physical configuration is not correct). In some cases, the resolution of a discrepancy might be to establish the acceptability of the existing physical configuration and change the design requirements. Technical approval from the design authority (i.e., design verification) should be

obtained on discrepancy resolutions to ensure that the final configuration is consistent with the design requirements. The end product of the process is as-built documentation that has been both field-verified and design-verified.

2.5.3.3 Periodic Equipment Performance Monitoring

This ongoing assessment function verifies that selected SSCs continue to be able to perform their intended functions (i.e., meet their design requirements). Equipment performance monitoring is included in the CM program because it is important to maintaining the bonds between the physical configuration and the design requirements. The results of this monitoring function should be used to correct any equipment deficiencies that cause the equipment to deviate from the design requirements and to identify any root causes of performance degradation.

The fully developed program should include (1) implementing procedures established to specify and control periodic equipment performance monitoring, (2) acceptance criteria defined consistent with the design requirements, and (3) testing procedures established for frequently performed tests.

Performance monitoring programs should be implemented to routinely monitor, collect (using calibrated instrumentation), trend, and analyze performance data (including thermal, hydraulic, electrical, and mechanical data) for SSCs within the CM program. The methods of implementation should include procedures, checklists, or other guidance documents necessary to conduct these activities. Specific facility personnel, such as system engineers, should be assigned to each SSC and held responsible for the performance monitoring activities on assigned SSCs. This responsibility should include the establishment of performance goals and acceptance criteria consistent with the associated SSC design requirements. Examples of major tests that should be included in the performance monitoring program are as follows:

- Heat exchanger performance tests (e.g., fouling and heat transfer rate)
- Pump performance tests (e.g., head versus flow tests)
- Valve performance tests (including stroke times)
- Vibration monitoring for major rotating equipment
- Battery capacity and performance tests
- Other major equipment tests, as applicable (e.g., diesel generators and inverters)

The frequencies for each test should be specified in procedures and periodically reviewed to ensure adequacy. Reviewing trend graphs of collected equipment data at specified intervals is a proven, effective approach. For example, if the trend graph indicates that the equipment likely will not meet the acceptance criteria at or before the next scheduled test, an adjustment in the test schedule and other maintenance actions would be necessary.

For cost-effective implementation of this function, the timely recognition of interfaces with existing program requirements is necessary. The equipment monitoring function interfaces with operations, maintenance, and systems engineering programs. In some cases, adjustments to existing programs may be sufficient to satisfy the need for ongoing CM assessments. Existing programs should be reviewed to determine whether they are adequately oriented to maintain configuration and support the objectives of the CM program and are adequately integrated with other important CM functions. They should also be reviewed to determine whether their scope is sufficient to address the full breadth of SSCs within the CM program.

Surveillance testing is typically performed to satisfy regulatory, code, or other requirements to ensure operability of the equipment within established limits. For SSCs included in the CM program the results of surveillance testing should be used to detect and correct any deficiencies that cause the equipment

to deviate from the design requirements. Surveillance testing techniques are similar in many ways to those used In SSC performance monitoring. A comprehensive surveillance testing program ensures that the identified testing is scheduled and performed, the results are reviewed and trended, and necessary corrective actions are taken to return equipment performance to within the design requirements.

The periodic equipment performance monitoring function should take credit for periodic surveillance testing, where appropriate. Full integration of the surveillance test program with other periodic equipment monitoring can provide efficiencies in manpower and scheduling. Periodic testing, beyond that in the TSR surveillance requirements, may be adjusted both In frequency and degree of technical content based on the importance of the SSC or the particular SSC function. The origin of various testing requirements should be documented and maintained.

DOE 4330.4A, *Maintenance Management Program,* establishes preventive and predictive maintenance activities, such as tests, inspections, diagnostics, and trending. It further requires that a documented basis for planned preventive and predictive maintenance activities should be provided. Existing program to satisfy these Order requirements should provide a good interface with the CM program. Existing programs should be reviewed to determine whether they are adequately oriented toward maintaining configuration and achieving the associated CM program objectives.

Aging degradation monitoring is an important subset of equipment performance monitoring. It is directed at detecting the impact of known and anticipated aging degradation mechanisms. The MCA adjunct program will establish the technical basis for inspection and testing activities to trend important characteristics, anticipate the time of failure, and detect component degradation, which can result in systems and components operating outside their design requirements. The results of the MCA program will be reviewed by the design authority to determine which should be implemented within the periodic monitoring function (i.e., new design requirements). The assessments element supports the MCA adjunct program by coordinating implementation of identified monitoring actions performed throughout the life of the facility (i.e., during ongoing MCA implementation, after development).

2.5.3.4 Post-Modification Tests

Post-modification tests are performed each time an important SSC is installed or modified. These tests ensure that the SSC meets the design requirements and is verified to be operable prior to being placed into service initially or returned to service. This function prevents unintended changes from being introduced through errors during design or construction. For physical changes, these tests serve as a final and independent adequacy check of the design and technical reviews for the change. If a changed SSC fails to meet its acceptance criteria, ft may not be turned over for normal operations until either a technical review has been completed and any follow-up actions completed or the SSC is returned to its original condition and tested satisfactorily.

The fully developed program should include (1) implementing procedures established to specify and control post-modification testing and (2) acceptance criteria defined consistent with the design requirements. A recommended approach is to develop a generic procedure for identifying the post-modification tests to be performed and to invoke this procedure each time a facility change is made. For the post-modification tests to be effective, test conditions should be consistent with normal and emergency operating conditions and acceptance criteria should demonstrate that the applicable design requirements are met. The dominant factor affecting the level of effort for post-modification testing is the complexity of the design change involved.

2.5.4 SPECIFIC APPLICATION OF GRADED APPROACH: ASSESSMENTS ELEMENT

The initial assessments are important in identifying the strengths and weaknesses of existing programs and procedures. Accordingly, the more thorough these assessments are, the more representative and accurate the findings will be. Initial assessments may be adjusted based on facility grade. As defined in the program criteria, at least two vertical slices (one on a principal safety system) and at least two horizontal slices (one on change control and one on a topical area) should be conducted. However, for some small facilities that have limited hazards and are not complex, the number of vertical slices and horizontal slices may be adjusted. The following table presents different levels of implementation for the initial assessments, based on the facility grade.

ASSESSMENT TYPE	FACILITY GRADE			
	High	Medium	Low	Minimal
Vertical Slice Principal Safety System	Necessary	Necessary	Necessary	Recommended
Horizontal Slice Change Control	Necessary	Necessary	Recommended	Optional
Second Vertical Slice	Necessary	Recommended	Recommended	Optional
Horizontal Slice Topical Area	Necessary	Recommended	Optional	Optional

This matrix applies to the case in which the facility grade is being applied directly to the CM program general criteria. In other words, no other graded approach considerations (such as facility remaining lifetime, etc.) have been applied. With application of other graded-approach considerations, the implementation level may be adjusted further and this matrix would serve as an example of relative priorities.